

The conservation significance of the biota of Barrow Island, Western Australia

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Abstract

Offshore islands are often important in conservation because of the presence of locally endemic species and for acting as refuges for native wildlife from the impacts of invasive species and inappropriate development. Barrow Island, a small, semi-arid island off the Pilbara coast of north-western Australia, has maintained the integrity of its terrestrial and aquatic biota despite sporadic incursions by invasive species and the operation of commercial oil extraction and liquified natural gas processing for over 50 years. We collate information from a wide range of sources to provide a framework to inform the ongoing management of the terrestrial and aquatic fauna and flora species that have conservation significance on the island. These include endemic flora and fauna; species listed as threatened by state, national and international authorities; species that are rare or extinct in other parts of their original range; species of biogeographic significance; and migratory birds and marine fauna of national and international significance. In addition, Barrow Island has been of value in acting as a source area for translocations of vulnerable and endangered mammal species that have been eradicated in other parts of their range. The many species with conservation significance and their use in successful translocation programs demonstrates the island's national and international importance for conservation. In addition, Barrow Island provides exemplary opportunities for research on effective co-management of development and conservation, on mitigation and prevention of the invasion and impacts of exotic species, and on the influence of historical biogeographic processes on the distributions and evolution of biota.

Keywords: island conservation, endemism, rarity, migratory fauna, invasive species, biogeography

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INTRODUCTION

Barrow Island (20°47'52.8"S, 115 24'21.6"E; Fig. 1) off the coast of north-west Western Australia is one of Australia's most important island sanctuaries. Its significance has long been recognised with its declaration in 1910 as a 'Class A' Nature Reserve, the highest level of protection available under Western Australian legislation. Although this small, semi-arid continental island covers just 236 km² and is located 56 km offshore, it has many resident and migratory taxa of conservation significance, and a relatively high diversity of terrestrial fauna and flora. Only 11 (2%) of 512 Australian islands contain more mammal species than Barrow Island and most (9) of those 11 islands are larger in area (Abbott & Burbidge 1995; Burbidge & Abbott 2017; Tables 1, 2). Three smaller islands with the same or more native mammals than Barrow Island are located much closer to the mainland. Of these, Augustus Island (Fig. 1) lies within 6 km of Western Australia's mainland, whereas the other two

(Phillip Island, Victoria; Burrup, Western Australia; Fig. 1) are connected to the mainland by artificial causeways. During periods of lower sea-levels, they were separated from the mainland by coastal plains, mudflats or swamps (Kirkwood & Johnston 2006; Stankowski & Johnson 2014). Likewise, there are more plant species on Barrow Island than on various other offshore arid or semi-arid islands of similar size (Main & Yadav, 1971; Table 3). Endemic species, subspecies and forms have developed on the island (Buckley 1983; Driskell *et al.* 2002) but inbreeding depression has been detected in some taxa (Eldridge *et al.* 2004).

Conservation and development co-exist on Barrow Island. Commercial oil-production industry began on the island in 1964 and in 2009 liquefied natural gas (LNG) processing facilities were established to process gas from the Gorgon reservoir, 70 km to the north-west of the island (Fig. 1). Ongoing expansion of sub-sea gas drilling and transfer infrastructure from the Gorgon gas fields will sustain the LNG project for a lifespan of 40 years (Chevron 2018). Multi-purpose land-use on the island has been enabled by a strict quarantine and environmental management programme with regular surveillance and monitoring for invasive species (Burbidge 1999; Burbidge

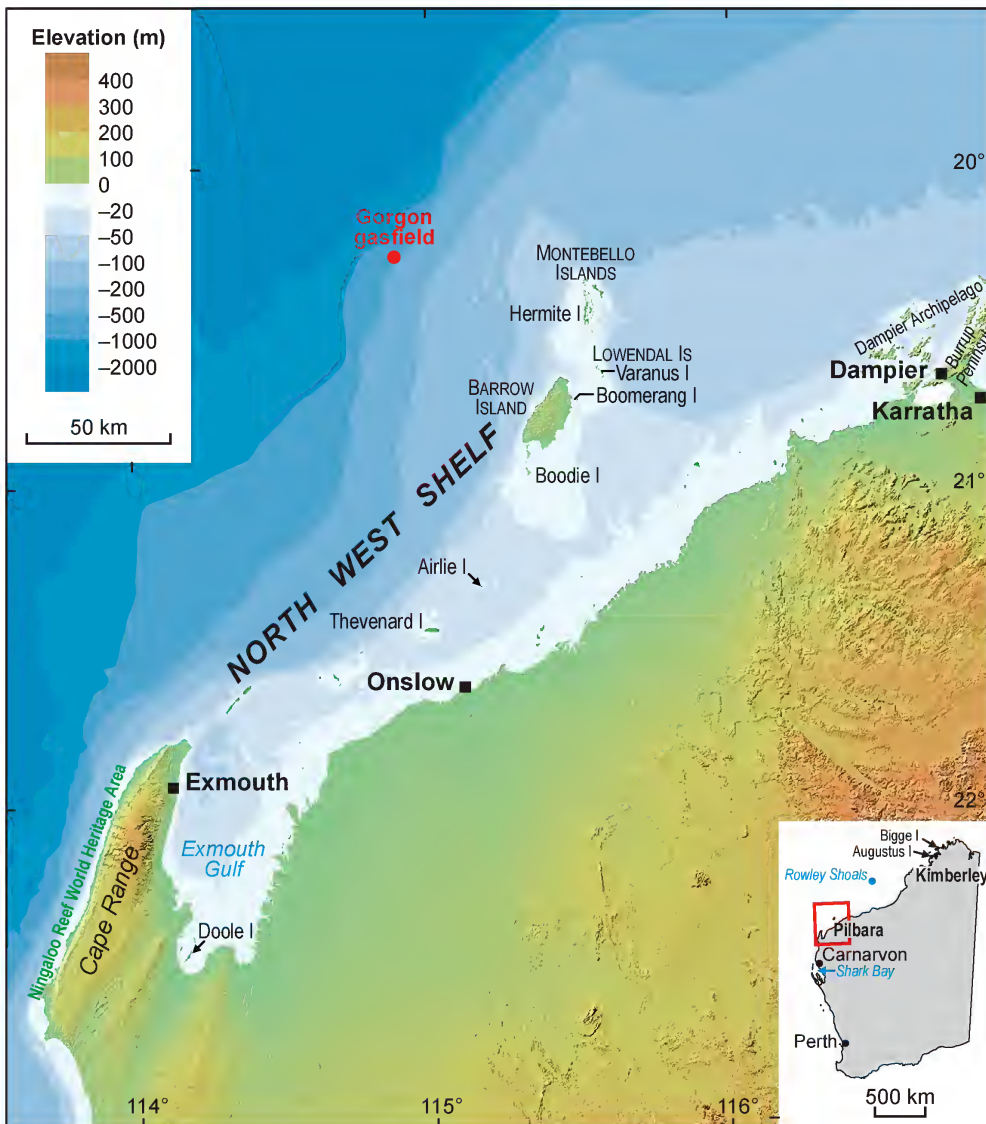


Figure 1. The location of Barrow Island within Western Australia.

& Manly 2002; Greenslade *et al.* 2013a, 2013b; Scott *et al.* 2017). The recent opening of a university science centre on the island will support further research into environmental protection and industrial development in fragile ecosystems (Perera 2018).

Like Barrow Island, other areas of Western Australia are subject to rapid development for extraction and export of mineral and gas resources. For example, several major offshore LNG projects have commenced in recent years (Environmental Protection Authority 2007; Government of Western Australia 2017). The petroleum industry is the state's second-most economically valuable industry and offshore LNG is the most valuable petroleum product, accounting in 2017 for \$14.9 billion (Government of Western Australia 2017). The North West Shelf, where Barrow Island is located, produces approximately 59% of the state's oil and 93% of its gas (Department of Environment and Conservation 2006).

The establishment of LNG processing facilities on Barrow Island required approval from the Western Australian and Australian governments. Approvals were granted in 2007 and 2009, despite opposition from

the state authority in which the nature reserve is vested (Conservation Commission of Western Australia 2003), the Western Australian Environmental Protection Authority (2009), and a former senior state government scientist (ABC Radio National 2009). Stringent environmental conditions were imposed on the developers (Chevron, ExxonMobil and Shell), including quarantine controls on all materials and personnel travelling to the island, regular surveillance for exotic species, and a requirement for compliance with over 20 environmental management plans. Additional commitments from the developers included conservation undertakings worth approximately AUD\$150 million and funding to enable Department of Environment and Conservation staff to be based on the island for management of any impacts on marine conservation over the life of the project (Department of State Development 2009).

The agreement of the consortium reflects the high economic value of the regional LNG reserves but also Barrow Island's high national and international conservation significance. The flora and fauna (except for some invertebrate groups) were well known because

Table 1

Australian islands with equivalent or greater number of extant (and extinct) native and exotic or introduced mammals compared to Barrow Island, ranked by area (data from Abbott & Burbidge 1995; Burbidge & Abbott 2017).

Island	Area (ha)	No. native species	No. non-native species
Phillip Island, Vic*	10 116	16 (+1 extinct)	10 (1 now absent)
Burru (Murujuga, Dampier Is), WA*	11 804	15 (+1 extinct)	5
Moreton Island, Qld	17 021	10	5
Bigge Island, WA	17 128	9	0
Bribie Island, Qld	17 500	12	2
Augustus Island, WA	18 929	13	0
Barrow Island, WA	23 569	13	2 (2 eradicated)
North Stradbroke Island, Qld	26 344	17	3
Vanderlin Island, NT	27 690	11	5
Hinchinbrook Island, Qld	31 756	18	4 (2 now absent)
Bruny Island, Tas	36 735	15	8 (1 now absent)
Cape Barren, Tas	46 220	9 (+2 extinct)	5
King Island, Tas	109 100	13 (+4 extinct)	9
Flinders Island, Tas	135 900	15 (+2 extinct)	8 (1 now absent)
Bathurst Island, NT	169 300	14	3
Fraser Island, Qld	165 280	2	3 (1 now absent)
Groote Eylandt, NT	228 500	28	1
Kangaroo Island, SA	442 000	18 (+4 extinct)	13 (3 now absent)
Melville Island, NT	578 000	21	4
Tasmania	6 452 000	33 (+1 extinct)	12

*Burru and Phillip Island are coastal islands linked to the mainland by causeways. Burru is also connected at low tide. Bigge Island is about 6 km offshore

of sponsorship from the Western Australian Petroleum Exploration Company, which has operated oil wells over the southern part of the island since 1964. However, intermittent surveys of fauna have been undertaken only since 1991; e.g. sampling of the stygofauna (aquatic fauna living within groundwater systems) and troglobitic fauna (air-breathing subterranean fauna living in caves, cavities and fractured rock; Humphreys *et al.* 2013). The government response to Chevron Australia's (2005) draft environmental impact statement was that extensive surveys would be undertaken and they should include invertebrates. This has led to over 2000 new records of species and new taxa being described.

Broader inventories of the natural resources of the island, assembled as part of the Gorgon LNG development approval process, contributed

to the Environmental Impact Statement (EIS) and Environmental Review and Management Programme (Draft EIS/ERMP; see Chevron Australia, 2005) prepared for the federal Department of the Environment and Heritage and the Western Australian Environmental Protection Authority. The EIS documented the known biological and physical resources of the island, including the vegetation, floristics, vertebrate fauna, cave fauna (troglyphytes and stygofauna), invertebrates, and marine flora and fauna.

This article provides an updated evaluation of the conservation significance and management approach implemented for Barrow Island and its nearshore environments based on the species present and their state and national conservation status. Our objective is to collate information from a wide range of sources

Table 2

The number of native and exotic mammals on islands in north and north-western Australia of similar size (10 000–60 000 ha) to Barrow Island (NT and WA data from Abbott & Burbidge 1995; WA data also from Burbidge & Abbott 2017).

Island	Area (ha)	No. native species	No. exotic species
Burru (Murujuga, Dampier Is), WA*	11 804	15 (+1 extinct)	5
West Sir Ed Pellow, NT	13 373	5	0
Bigge Island, WA	17 128	9	0
Augustus Island, WA	18 929	13	0
Marchinbar Island, NT	21 190	9	0
Barrow Island, WA	23 569	13	2 (eradicated)
Elcho Island, NT	26 950	8	3
Vanderlin Island, NT	27 690	11	5
Croker Island, NT	31 000	1	6
Dirk Hartog Island, WA	58 640	5 (+10 extinct)	6 (2 now absent)

*Burru is a coastal island in the Dampier Archipelago connected to the mainland at low tide and by a road and rail causeway built in the mid-1960s

Table 3

Numbers of native and endemic plant taxa on various islands with arid or semi-arid vegetation.

Island	Region	Area (km ²)	No. native taxa (no. endemic)	Reference
St Helena	Angola–Namibian coast, Africa	122	70 (49)	Rowlands (no date)
Isla Santa Maria	Galapagos Islands	171	258	van der Werff (1983)
Sal	Cape Verde Islands	216	147	Duarte <i>et al.</i> (2008)
São Vicente	Cape Verde Islands (Macaronesia)	227	296	Duarte <i>et al.</i> (2008)
Barrow	North-western Australia	234	406 (2)	Chevron Australia (2005)
Maio	Cape Verde Islands	269	220	Duarte <i>et al.</i> (2008)
El Hierro	Canary Islands (Macaronesia)	269	426	Fernández-Palacios & Andersson (2000)
Dirk Hartog	North-western Australia	596	300	Abbott (1978)
Isla San Cristóbal	Galapagos Islands	552	291	van der Werff (1983)

as a reference for ongoing management of this and other Australian islands that require multi-purpose management for conservation and development. Other small island nature reserves in north-western Australia (i.e. Thevenard Island, Airlie Island, Varanus Island; Fig. 1) also support oil and gas production facilities, and drilling for gas has been approved only 50 km from the Ningaloo Reef World Heritage Area (Fig. 1; ‘Shell drilling permit for Ningaloo Reef approved’ 2011). Successful management of industry within environmentally important areas depends on comprehensive, current knowledge of environmental values and management of the risks and potential impacts on these values within a precautionary scientific approach (Greenslade *et al.* 2013a). We further comment on the importance of the island as a resource for research on co-management of development and conservation, mitigation and prevention of the invasion and impacts of exotic species, and the influence of historical biogeographic processes on the distribution patterns and evolution of regional biotic assemblages.

METHODS

The available literature on the terrestrial, subterranean and nearshore marine biota of Barrow Island was reviewed. This included the Gorgon development EIS (Chevron Australia 2005) and published scientific literature. The NatureMap database¹ (Western Australian Department of Parks and Wildlife) also was used to identify species present on Barrow Island. Lists of taxa were compared to their status as rare, threatened or protected taxa (as of 21–24 August 2018) under current biodiversity conservation legislation and conventions. These were the Western Australian *Wildlife Conservation Act 1950* and the Department of Environment and Conservation’s Threatened Flora Rankings for rare or priority plants; the Australian *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) using the SPRAT database² for taxa listed as threatened, as protected migratory species (i.e. under the Bonn Convention, the Japan–Australia Migratory Bird Agreement, the China–Australia Migratory Bird Agreement, and the Republic of Korea–

Australia Migratory Bird Agreement), or as protected marine or cetacean species; the International Union for Conservation of Nature (IUCN) Red List of threatened species; and the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). Comparison was also made (on 31 August 2018) with protected fish listed on the Western Australian *Fish Resources Management Regulations 1995* Schedule 2 Parts 1–3, which is under the *Fish Resources Management Act 1994*.

OVERVIEW OF THE ISLAND’S GEOGRAPHY AND BIOTA

Barrow Island is a continental island situated 56 km offshore. It is located near the edge of the continental shelf, regionally (115–122°E) termed the North West Shelf (Fig. 1). This broad submarine limestone shelf has chains of islands emerging roughly parallel to the mainland coast. Of these, Barrow Island, the Montebello Islands and nearby Lowendal Islands are the largest and farthest offshore (Chevron Australia 2005). This island complex includes over 315 low islands, islets and rocky stacks composed of limestone and cross-bedded sandstones (Department of Environment and Conservation 2006). During Quaternary high sea-level phases, such as at present, the islands are isolated from the mainland by a shallow (0–20 m deep) intervening ocean. However, during periods of lower sea levels, the islands are connected to the mainland across an exposed swampy coastal plain (Veth *et al.* 2017). Archaeological evidence indicates that Indigenous people lived on Barrow Island from around 51–46 ka until about 7 ka, when rising sea-levels caused the ultimate isolation of the island from the mainland (Veth *et al.* 2017). The first evidence of European awareness of the island is its inclusion on a Dutch navigational chart from 1628 (Moro & Lagdon 2013).

Barrow Island is 25 km long and 10 km wide, and rises to a maximum of 62 m above sea level (Department of Environment and Conservation 2006). It is composed primarily of limestone outcrops and deposits overlain by sands and gravels, with extensive rock platforms and rocky headlands on the west and east coasts (Chevron Australia 2005). The local climate is semi-arid and seasonally wet, with a mean annual rainfall of 306 mm but high inter-annual variability (Bureau of Meteorology 2011).

¹ <https://naturemap.dbca.wa.gov.au/>

² <http://www.environment.gov.au/cgi-bin/sprat/public/sprat.pl>

There are 34 vegetation types on the island (Mattiske & Associates 1993), comprised primarily of coastal and inland arid zone plants (Buckley 1983). These include 406 native vascular plant species and 14 introduced vascular plants (Chevron Australia 2005). The marine flora includes mangroves and seagrasses, macro- and micro-algae, and samphire plants in isolated, sheltered pockets in the upper intertidal zone (Department of Environment and Conservation 2006).

The terrestrial fauna includes 14 land mammals (including two bats), 128 terrestrial and migratory bird species, 43 terrestrial reptile species, one frog species, 37 subterranean vertebrates and invertebrates, and over 2200 terrestrial invertebrates (Chevron Australia 2005; Callan *et al.* 2011; Moro & Lagdon 2013; Burbidge & Abbott 2017). The marine fauna includes mammals (e.g. whales, dolphins, dugong), waterbirds, sea turtles, sea snakes, fishes, and a diversity of lesser known vertebrate and invertebrate species (Department of Environment and Conservation 2006).

There are 22 confirmed or putative non-indigenous invertebrates recorded from the island but currently no non-indigenous vertebrates (Chevron Australia 2005; Callan *et al.* 2011). Barrow Island has been invaded in the past by mice (*Mus musculus*; at least four times) and Black rats (*Rattus rattus*) but both species were eradicated (Burbidge and Abbott 2017, suppl. material). The absence of exotic vertebrates means that several mammal species are present that have been predated or out-competed on the mainland and some other offshore islands (Main & Yadav 1971; Burbidge & Abbott 2017).

Barrow Island lies within the Montebello–Barrow Island marine conservation reserve, comprising the Montebello Islands Marine Park (58 331 ha), Barrow Island Marine Park (4169 ha) and Barrow Island Marine Management Area (114 693 ha). The reserve is in the Pilbara Offshore marine bioregion (Department of Environment and Conservation 2006).

Barrow Island Nature Reserve was listed on Australia's Register of the National Estate in 1978 followed by the marine area in 2000. However, the Register of the National Estate was removed from the *Environment Protection and Biodiversity Conservation Act 1999* on 19 February 2012 and neither the island nor the marine area is on Australia's current Commonwealth Heritage List³. However, the island retains its Western Australian status and is subject to an intensive protection regime implemented by the State and petroleum interests.

CONSERVATION VALUES

Terrestrial vertebrate fauna

Barrow Island is one of Australia's most important mammal refuges and conservation areas. Four mammal subspecies and one island form are endemic to the island; six species are listed as threatened under state or national legislation or both; and one species is on the state list

of priority species (Appendix 1, Table 1; see Appendix 2 for a full list of taxa referred to in this paper). The island has been an important source for repopulating mammal species that have declined or become extinct elsewhere. As part of the environmental offset programs, a few threatened mammal species and two bird species have been translocated from Barrow Island to other Western Australian islands (Table 4). *Bettongia lesueur* was translocated to the Montebello Island group and Faure Island in Shark Bay, and also reintroduced to Boodie Island near Barrow Island (Burbidge & Abbott 2017). Similarly, there have been two conservation translocations of *Isodon auratus* from Barrow Island (reintroduction to Hermite Island, Montebello Island group; translocation to Doole Island, Exmouth Gulf; Fig. 1) and a reinvasion of the nearby Boomerang Island (Fig. 1) after the species was eliminated during the eradication of Black rats in 1983. *Lagorchestes conspicillatus* was reintroduced from Barrow Island to Hermite Island after its local extinction (Burbidge & Abbott 2017, suppl. material; Table 4). Three species (*I. auratus*, *B. lesueur*, *Trichosurus vulpecula* subsp. *arnhemensis*) have been translocated to the mainland, with Water rats (*Hydromys chrysogaster*) under consideration (Department of Environment and Conservation 2010, 2011; Table 4). Chevron's Threatened Species Translocation and Reintroduction Program was valued at \$10 million over 12 years (Department of Environment and Conservation 2011).

Many of the island's reptiles and birds are of conservation significance. There are distinct races or evolutionary significant units in some reptile species and the non-migratory avifauna that may have developed with the isolation of the island (Chevron Australia 2005). A subspecies of skink and a blind snake appear to be endemic to the island, and the blind snake is listed as a priority species (Appendix 1, Table 1; see 'Subterranean fauna'). There is also an endemic subspecies of bird (*Malurus leucopterus edouardi*, White-winged fairy wren) which is the most genetically distinct race within the species (Driskell *et al.* 2002), and which is listed as vulnerable nationally and in Western Australia. The land bird assemblage is depauperate, with only 16 of the 51 land bird species being residents or regular migrants. However, non-migratory birds on the island (e.g. Bar-shouldered dove *Geopelia humeralis*, Singing honeyeater *Gavicalis virescens*, Spinifexbird *Eremiornis carteri*) are assumed to have diverged genetically from mainland populations (Chevron Australia 2005).

Twelve of the island's birds are classified as threatened in Western Australia; two as endangered, nine as vulnerable and one as a priority species. Nine of these state-listed birds are also classified as threatened under the federal EPBC Act although only with partial overlap between the state and national classifications. Four birds are classified nationally as critically endangered, two as endangered, and three as vulnerable species. A total of 43 birds are categorised under the EPBC Act as migratory taxa and 63 as protected marine species, with some of these birds also being listed as threatened at state or national level. In relation to international conservation listings and conventions, five birds are classified as threatened (four endangered, one vulnerable) and seven as near threatened by the IUCN, with three birds listed on CITES schedule 2 (Appendix 1, Table 1).

³ <http://www.environment.gov.au/heritage/places/commonwealth-heritage-list> (viewed 15 September 2018)

Table 4

Conservation translocations of mammals and birds from Barrow Island to other WA islands and the mainland (from Burbidge & Abbott 2017, suppl. material; DEC 2010, 2011).

Animal	Translocation site	Region	Intervention
<i>Bettongia lesueur</i> (Barrow Island burrowing bettong)	Alpha Island	Montebello Islands	40 animals translocated in 2011
<i>B. lesueur</i>	Faure Island	Shark Bay	36 animals translocated in 1993 and 17 in 2002
<i>B. lesueur</i>	Boodie Island	Barrow Island group	36 animals reintroduced in 1993 after eradication in 1985–88 probably due to poisoning from rodenticide. Now common
<i>B. lesueur</i>	Lorna Glen	Northern Goldfields	65 animals translocated in 2010
<i>Isodon auratus</i> (Barrow Island golden bandicoot)	Hermite Island	Montebello Islands	161 animals reintroduced in 2010 after their local eradication between 1912 and 1950
<i>I. auratus</i>	Doole Island	Exmouth Gulf	92 animals translocated in 2010 and 2011
<i>I. auratus</i>	Boomerang Island	Barrow Island group	Reinvasion from Barrow Island
<i>I. auratus</i>	Lorna Glen	Northern Goldfields	164 animals translocated in 2010
<i>Lagorchestes conspicillatus</i> (Barrow Island spectacled hare-wallaby)	Hermite Island	Montebello Islands	111 animals reintroduced in 2010 after local extinction between 1912 and 1950
<i>Trichosurus vulpecula</i> ssp. <i>arnhemensis</i> (Northern brushtail possum)	Cape Range National Park	South of Exmouth, Pilbara	104 animals translocated in 2010
<i>Eremiornis carteri</i> (Spinifex bird)	Hermite Island	Montebello Islands	Reintroduction in 2010 with 35 birds and restocking in 2011 with 12 birds
<i>Malurus leucopterus edouardi</i> (Barrow Island black and white fairy wren)	Hermite Island	Montebello Islands	Reintroduction in 2010 with 27 birds and restocking in 2011 with 10 birds

Barrow Island is a significant staging post for southward migrating birds, a destination site, and a staging site for many migratory species (Chevron Australia 2005). Some migrant species rest on the island in the non-breeding summer season whereas other birds ‘over-winter’ on the island (Chevron Australia 2005). The island supports large numbers of waders and waterbirds, including some species such as the Ruddy turnstone (*Arenaria interpres*) and Bar-tailed godwit (*Limosa lapponica*) that have declined over the last 30 years (Bamford & Moro 2011). There are 50 species of marine littoral avifauna on the island (Chevron Australia 2005).

The island has been designated an Important Bird Area (IBA) under the Birdlife International programme due to its importance to migratory waders traversing via the East Asian–Australasian Flyway (EAAF; Chevron Australia 2005 appendix C3; Bamford & Moro 2011). Because of its importance for seven migratory waders, the island ranks equal tenth among the 147 significant sites in Australia for migratory waders, the fifth most important for the Grey-tailed tattler (*Tringa brevipes*) and fourth most important for the Ruddy turnstone (Bamford & Moro 2011).

The island also qualifies as an internationally significant migratory wader site under the Ramsar Convention. It meets the 1% of EAAF population threshold for five species, the staging threshold of supporting 0.25% of populations for eight species during seasonal migrations, and a 1% of global population threshold for one species (Chevron Australia 2005

appendix C3; Bamford & Moro 2011; Appendix 1, Table 1). Barrow Island supports over 1% of the species’ population in the EAAF for the trans-equatorial migratory waders: Grey-tailed tattler, Ruddy turnstone, Red-necked stint (*Calidris ruficollis*), Greater sand plover (*Charadrius leschenaultii*) and Lesser sand plover (*C. mongolus*). It meets the staging criterion of at least 0.25% of a species’ population during southward or northward seasonal migrations for eight migratory waders: Red-necked stint, Bar-tailed Godwit, Grey-tailed tattler, Ruddy turnstone, Greater sand plover, Common greenshank (*Tringa nebularia*), Lesser sand plover and Sanderling (*Calidris alba*) (Chevron Australia 2005; Bamford & Moro 2011).

The island is regionally significant for containing 2.4 – 6.6% of the known populations of three migratory species (Grey-tailed tattler, Ruddy turnstone, Red-necked stint) and at least 1% of the global population of the Red-necked stint (Chevron Australia 2005, appendix C3; Bamford & Moro 2011; Appendix 1, Table 1). There are also significant populations of two non-migratory birds: the Fairy tern (*Sterna nereis*) which moves only locally, and the northern race (*ophthalmicus*) of the Sooty oystercatcher (*Haematopus fuliginosus*) which is an island resident (Chevron Australia 2005; Appendix 1, Table 1).

Marine vertebrate fauna

Marine vertebrates of conservation significance found on or near Barrow Island include cetaceans, sea turtles, sharks and syngnathids (seahorses, sea-dragons and

pipefish). All 40 species of cetaceans likely to be present in the area (Appendix 1, Table 1) are protected under the EPBC Act. Three species of turtle regularly nest on Barrow Island (Green turtles *Chelonia mydas*; Flatback turtles *Natator depressus*, Hawksbill turtles *Eretmochelys imbricata*), whereas occasional nesting by Loggerhead turtles (*Caretta caretta*) has been recorded and another three species are likely to be present near the island (Appendix 1, Table 1; Department of Environment and Conservation 2006). The Western Australian Hawksbill population is the largest remaining in the Indian Ocean.

All Australian sea turtles are protected under state and national conservation legislation, by the Bonn Convention for the protection of migratory animals and under CITES Schedule 1 (Appendix 1, Table 1). All waters within a 20 km radius of Barrow Island were identified in the National Recovery Plan for Marine Turtles in Australia (Environment Australia 2003) as critical habitat for the survival of Green turtles. Sharks are protected under state and national conservation legislation; species that visit the Barrow Island area include the Whale shark (*Rhincodon typus*), Grey nurse shark (*Carcharias taurus*) and Great white shark (*Carcharodon carcharias*). Two species of seahorse recorded near the island are protected under national legislation: Spiny seahorse (*Hippocampus histrix*) and Yellow seahorse (*H. kuda*) whereas two others are protected in Western Australia: Leafy seadragon (*Phycodurus eques*) and Common seadragon (*Phyllopteryx taeniolatus*).

In relation to Western Australia's conservation legislation, five marine vertebrates found near Barrow Island are listed as endangered, eight as vulnerable, four as priority taxa, one as conservation dependent, and two as other specially protected fauna. Five species are listed as protected fish (Appendix 1, Table 1). Most of these taxa are also considered to be threatened nationally; two marine vertebrates are listed as critically endangered nationally, five as endangered nationally, and nine as vulnerable nationally. Four of the marine vertebrates have also been classified by the IUCN as threatened: one as critically endangered (Leaf-scaled sea snake *Aipysurus foliosquama*), one as endangered (Whale shark), and 11 as vulnerable; with 24 identified as data deficient. Twenty-two marine vertebrates potentially present in the area are protected migratory species, 47 are protected marine species, and 52 are listed under CITES.

Terrestrial invertebrates

The invertebrate taxa of Barrow Island are an important component of the fauna of the island because of their high species richness and contribution to ecosystem processes (Chevron Australia 2005). However, their conservation significance cannot be evaluated because a high proportion are yet to be described. Based on an intensive survey of terrestrial invertebrates on Barrow Island from 2005 to 2009, Callan *et al.* (2011) recorded 1873 species and morphospecies from 321 families and 27 orders, of which only 292 are named species. Majer *et al.* (2013) estimated 2481 invertebrates are present while noting that the fauna varied considerably between seasons, years and even weeks, and with recent rainfall as well as with distance from the coast. Further descriptions and reporting on these surveys were collated in Gunawardene *et al.* (2013).

A few well-studied taxa, generally few in species, vagile or of possible economic importance, are relatively well known. For instance, all species of the Odonata (four species), Embiidina (one species) and Isoptera (27 species) can be named and are widespread (Callan *et al.* 2011; Jones 2013). However, in some groups, the percentage of described species is low and the knowledge of endemism and conservation status is poor. This reflects the species richness of these groups, a paucity of older and more regionally extensive surveys, and limited taxonomic expertise.

The Gorgon development EIS (Chevron Australia 2005) identified 22 terrestrial invertebrate taxa as endemic to Barrow Island and one marine invertebrate as restricted to sand bars in the Montebello–Lowendal–Barrow Island region (Appendix 1, Table 2). These taxa are considered to be 'short range endemics' (SRE; i.e. invertebrates restricted in range by poor dispersal abilities or opportunities that are restricted to areas of less than 10 000 km²; Harvey 2002). Surveys on Barrow Island have found over 40 potential SRE taxa, including species of spider, pseudoscorpions, centipedes, millipede, scorpions and land snails (Chevron Australia 2005). For example, there are eight species of arachnid and two terrestrial millipedes that are endemic to the island based on current records (Appendix 1, Table 2). Three species of camaenid land snails (*Quistrachia montebelloensis*, *Rhagada barrowensis*, *R. plicata*) found on Barrow Island and nearby islands have maximum ranges of only 22–70 km (Johnson *et al.* 2013).

Less conclusively, there is a terrestrial mollusc that, on current records, is an endemic whereas one pseudoscorpion is probably endemic (J. Majer pers. comm. 2011) and seven species of Collembola may be endemic (Greenslade 2013; see below). Several new species of silverfish (*Heterolepisma parva*, *Qantelsella maculosa*, *Q. aurantia*, *Hemitelsella transpectinata* (syn. *Acrotelsella transpectinata*), *Xenolepisma perexiguum*) were described from specimens collected on Barrow Island by Smith (2013, 2015), but he noted that further work is needed on the group. Similarly, Mound (2013) referred to a few thrip (Thysanoptera) species only known from Barrow Island (*Desmothrips barrowi*, *Gynaikothrips* sp., *Podothrips barrowi*) but reasoned that the poor knowledge of the mainland fauna meant that these species could not be considered yet as endemic to the island. The booklouse species *Lithoseopsis humphreysi* (Psocodea: Amphientomidae) is currently known only from Barrow Island and Cape Range (Taylor 2013). In the terrestrial isopods (Crustacea: Oniscidea), Judd & Perina (2013) indicated that at least six of the 18 described species are potential SREs.

More taxonomic studies as well as surveys in the Pilbara and Cape Range are required to clarify the true level of invertebrate endemism. Using the Collembola as an example, they have been intensively collected over a period of four years in all the island's habitats, including the intertidal zone and subterranean habitats. Sampling used pitfall traps, sweeping, extraction of soil cores, leaf litter samples, emergence traps and yellow pans. Collembola abundance is largely dependent on rainfall and at least one species was only detected after a heavy rainfall. Seventy-one species have been distinguished including 14 species from the marine littoral zone, one new generic record (*Calx*, family Entomobryidae)

for Australia, and two possibly three exotic species (Greenslade 2013). The level of island endemism is low with most species probably also present elsewhere in northern Australia (Greenslade 2013). However, only 25% of the taxa had been described or were from a known species group (Greenslade 2013). Some taxa (e.g. *Calx* sp. and two intertidal species cf. *Kenyura* sp. and *Caufrenyllodes* sp.) are only known from one location. Two species of *Drepanura* (family Entomobryidae) are endemic to Barrow Island based on current records (Ma *et al.* 2015; P. Greenslade pers. comm. 2019). At least one, and possibly more, subterranean Collembola is endemic (see 'Subterranean fauna' below).

Endemism is also low in the ants (Hymenoptera) from Barrow Island. Of the approximately 117 species with 76 named, five may be endemic with four of these being un-named taxa (Heterick 2013). Similarly, only one of 11 species of parasitoid wasps in the genus *Elasmus* is potentially endemic but again further work is needed on the wasp fauna of Barrow Island and the Pilbara (Stevens *et al.* 2013).

Subterranean fauna

The north-western Australian region may contain one of the more systematically diverse subterranean faunas globally, with many relict obligate stygofauna and a considerable level of regional endemism (Eberhard *et al.* 2005; Humphreys *et al.* 2013). Sixty-three species of stygofauna and 19 troglobitic fauna have been documented for Barrow Island (Humphreys *et al.* 2013). However, there are likely to be more species on the island as many areas have not been surveyed (Humphreys *et al.* 2013). In the Collembola, one endemic species *Acanthocyrtus barrowensis* which lacks pigmentation is known but further investigation is needed to assess whether this is due to the taxon occupying a subterranean habitat or just developing in low light intensity (Greenslade unpubl. report). Three other subterranean species (*Pseudosinella* sp., *Megalothorax* sp., *Cyphoda* sp.) also may be island endemics (Greenslade 2013).

Most of the stygofauna are invertebrates, primarily of the phyla Arthropoda and Annelida. The anchialine amphipod fauna (inhabiting underground waters with marine influence) is particularly notable for endemism with 12 species described from Barrow Island specimens (Bradbury & Williams 1996a, 1996b; Bradbury 2002).

There are two vertebrate stygial taxa (order Chordata): the endemic Blind Cave Gudgeon *Milyeringa justitia* that has been only recorded from three bores on Barrow Island, and a cave synbranchid (Swamp eel) *Ophisternon* sp. which was photographed at one site but not collected (Larson *et al.* 2013). The Swamp eel is presumed, at the moment, to be *O. candidum*, which is widely distributed on Cape Range peninsula and in the west Pilbara region (Humphreys *et al.* 2013).

The most common troglobite on Barrow Island is the schizomid *Draculoides bramstokeri*, which is also known from Cape Range (Chevron Australia 2005; Humphreys *et al.* 2013). Other troglobitic or stygobitic fauna of the island include species of arachnid, pseudoscorpion, cockroach, isopod, hexapod, millipede and a blind snake (Aplin 1998; Car *et al.* 2013; Humphreys *et al.* 2013; Appendix 1, Table 2).

A subterranean blind snake (*Anilius longissimus* syn. *Ramphotyphlops longissimus*) was collected in 1995 when it emerged with well casing that may have punched through a deep cavern (Aplin 1998). The blind snake is known from only one specimen but is extremely distinctive and not obviously allied to any other known taxon (Aplin 1998). It may be the only known troglobitic reptile globally (Chevron Australia 2005) and is on the state priority species list. Similarly, the millipede *Speleostrophus nesiotes* is the first known troglobitic spiroboloid millipede and is likely to be a short range endemic restricted to Barrow Island (Chevron Australia 2005; Car *et al.* 2013). Car *et al.* (2013) also reported a new species of Haplodesmidae millipede endemic to Barrow Island that is probably troglobitic and likely to be a new genus, and an endemic epigeal millipede *Boreothesperus dubitalis*. Another notable endemic of Barrow Island is the troglobitic scorpion *Aops oncodactylus*; it is the only known troglobitic urodacid, the only one known from continental Australia, and its ancestor appears to represent an early branch in the family Urodacidae (Volschenk & Prendini 2008). Eleven of the stygofauna and two other troglobites on Barrow Island are listed under Western Australian legislation as vulnerable species, while the Blind cave gudgeon and Blind cave eel are also recorded as nationally vulnerable under the EPBC Act (Appendix 1, Table 1).

Terrestrial flora

With 406 native plant species (Chevron Australia 2005), Barrow Island has a relatively high level of species richness compared to other islands of similar size and vegetation type (Table 3). In contrast, tropical islands in north-eastern Australia have higher rainfall and more plant species: Whitsunday Island, Qld (20°15'S 148°58'E, 109 km²) has 495 species and Hinchinbrook Island, Qld (18°20'S 146°14'E, 399 km²) has 600 plant species (Batianoff & Dillewaard 1997).

The Barrow Island flora does not display as high a level of endemism as the vertebrate fauna but is regionally significant because of rare and priority taxa, other taxa that may be restricted to the island, and many that are at their limit of range (Chevron Australia 2005). There are two plant forms or variants that are endemic to the island (Appendix 1, Table 3). These are a variant of *Cucumis variabilis* (Telford *et al.* 2011) and a dwarf form of *Acacia trudgeniana* (Maslin & van Leeuwen 2008). There are also two priority plant taxa on the island (Appendix 1, Table 3): *Helichrysum oligochaetum* and *Corchorus congener*. The island has 50 species at the northern limit for plants of Cape Range and southwards, 122 at the southern limit of range for plants of the Kimberley region, and 193 at the western limit for plants of the Pilbara region (Chevron Australia 2005, appendix C1 p7 – attachment A). In addition, Chevron Australia (2005) referred to five plant taxa that are of conservation significance on Barrow Island as they are restricted to creek beds and gullies—habitats that have been reduced locally through human disturbance (Appendix 1, Table 3).

Marine flora and invertebrate fauna

The marine flora generally is widespread, being connected with assemblages in the Dampier Archipelago and the Rowley Shoals to the north by the Leeuwin

Current (Department of Environment and Conservation 2006; Fig. 1). Most marine flora (and fauna) species in the bioregion are tropical and widely distributed throughout the Indo-West Pacific region due to natural oceanographic links.

Nevertheless, there may be many endemic and undescribed species because of habitat diversity (Department of Environment and Conservation 2006). Even at a small scale, habitat differentiation (e.g. from wave energy) has been shown to influence benthic species distributions across the region and specifically between offshore and nearshore assemblages; some intertidal molluscan genera (e.g. *Conus*, *Modiolus*, *Rhinoclavis*) demonstrate this with some species restricted to the west coast of Barrow Island with congeners along the east coast (Department of Environment and Conservation 2006). Six species of macro-algae have only been recorded from near Barrow Island but the region has not been systematically surveyed.

A recent study of scleractinian corals found 15 species not recorded elsewhere in Western Australia and assessed the diversity of corals in the Pilbara vicinity of Barrow Island to be significant at regional, national and international scales (Richards & Rosser 2012). Thirty-nine coral species in the Barrow–Montebello Island assemblage are listed by the IUCN as vulnerable to extinction, including one of the locally dominant species, *Pectinia lactuca* (Richards & Rosser 2012; Appendix 1, Table 4). The area may provide a high latitude refuge for these and other coral species from climate change (Richards & Rosser 2012).

BIOGEOGRAPHIC AFFINITIES

The composition of the biota of Barrow Island reflects several biogeographic patterns and the disparate evolutionary pathways of its constituent species through the Quaternary. On a geological timescale, Barrow Island is more typically a land-bridge island and an extremity of the Australian mainland rather than a remote offshore continental island (Fig. 1). The last 2.4 Ma of the Quaternary have encompassed over 20 major climatic fluctuations with the continental shelves exposed at least eight times (Galloway & Kemp 1981; Colhoun & Peterson 1986). Based on modelling of sea levels, Barrow Island may have been geographically isolated from the Australian mainland (i.e. sea levels were up to 20 m lower than present) for only about 25% of the last 500 ka (Bintanja *et al.* 2005) or about 14% of the last 150 ka (Grant *et al.* 2012). The biogeographic patterns reflect at least three types of species history (see Appendix 1, Table 5).

Endemic species with close relationships to onshore conspecifics or congeners

Many subterranean taxa are endemic to Barrow Island and have close relationships with conspecifics or congeners at Cape Range and to a lesser degree the Pilbara coastal plain (Eberhard *et al.* 2005, table 1). The subterranean fauna of the Barrow Island – Cape Range – Pilbara coastal region is one of the most biodiverse globally, which Bradbury and Williams (1997) attributed to the stranding of ancestral founder populations in small discrete subterranean basins followed by

regressive evolution. Barrow Island and Cape Range occur in geologically similar sub-basins within the Northern Carnarvon geologic basin. Their thick Mesozoic sequences of limestone, claystone, sandstone and calcarenite differ from the adjacent onshore parts of the Carnarvon Basin which are dominated by Palaeozoic strata with a veneer of Mesozoic and Cainozoic sediments (Hocking *et al.* 1987). These differ substantially from the volcanic and metamorphic rocks of the Precambrian Pilbara Craton farther east and north-east on the mainland (Hocking *et al.* 1987).

Stygobionts have endured in this semi-arid region because the subsurface habitats provide lower temperatures and relatively stable environmental conditions (Bradbury & Williams 1997). Some of the amphipod stygofauna on Barrow Island live in waters with marine influence and are derived from closely allied marine ancestors (thalassostygobionts e.g. the anchialine troglobite *Liagoceradocus*). Others occupy subterranean freshwater habitats but are derived from marine ancestors and their ranges overlap with areas of marine transgressions during the Cretaceous (e.g. many hadzioids such as Barrow Island's *Nedsia* species and *Bogidomma* genus; Bradbury & Williams 1996a, 1997). The biogeography of the stygofauna, anchialine fauna and troglofauna is strongly linked with Gondwana, the Tethys and rainforests, respectively (Humphreys *et al.* 2013). The antiquity of elements of the biota is further indicated by the presence of endemic genera (e.g. *Bogidomma*) and a relict scorpion (*Aops oncodactylus*), whose ancestor is believed to belong to an early branch of the family Urodacidae.

Resident terrestrial taxa closely related to Pilbara biota

This biogeographic pattern is shown by resident terrestrial taxa, a few of which have a low level of subspecific variation from mainland taxa in the Pilbara and broader region. The fauna, including invertebrates such as ants for example, is generally a subset of the Pilbara biota, has low endemism and, in the case of birds, is depauperate in species with only 16 of the 51 species of terrestrial avifauna being residents or regular migrants to the island (Main & Yadav 1971; Chevron Australia 2005; Heterick 2013). Nevertheless, there are four endemic subspecies and one island form amongst the resident small mammals, and one endemic subspecies of an epigeal (i.e. not subterranean) reptile and of a non-migratory bird. In addition, two forms or variants of vascular plants are endemic to the island, and about 30 terrestrial invertebrate taxa are short-range or island endemics. Notably, two closely related species of the highly vagile fly family Dolichopodidae (Diptera) have been recorded, one that is endemic to Barrow Island and the other to Cape Range (Bickel 2013). Forty-one species of this family are known from the Pilbara. Bickel (2013) surmised that some of the Dolichopodidae distributions reflect a sweepstake effect of progressive species impoverishment towards the Pilbara of tropical and monsoonal taxa that are able to persist in protected mesic sites, but also that a widespread richer mid-Tertiary biota has since fragmented into isolated pockets.

Overall, the level of endemism amongst the terrestrial taxa of Barrow Island indicates selective pressure on resident taxa from intermittent isolation with sea-level

and climatic changes through the Quaternary. Amongst the birds for example, the subspecific divergence evident in the White-winged fairy wren relates to their localised distribution and lack of genetic interchange between populations on Barrow Island and other parts of the species' range. There has been persistence of habitats for these taxa even with higher past sea levels—for example, at 128 ka, the sea level has been estimated to have been about 7 m higher than today, which may have caused the inundation of about one-fifth of the island (Appendix 1, Table 6). However, storm surges would have further reduced the available habitats, as would intermittent disturbance of habitats from cyclones. Barrow Island is located in an area of comparatively high cyclone frequency and intensity (Jaffrés *et al.* 2018, fig. 15) and has experienced the strongest winds recorded globally (408 km/h) during the passage of Cyclone Olivia in 1996 (Bureau of Meteorology 2018). Many non-vagile species are likely to be highly vulnerable to extirpation by such events on Barrow Island, although some of these taxa, like Aboriginal people, would have traversed the coastal plain environments exposed during lower sea levels.

Taxa generally lacking localised variation

The third biogeographic pattern is evident in the many currently vagile or widespread species that have been recorded for Barrow Island and is reflective of their dispersive abilities. These taxa generally lack any localised variation related to their presence on or close to Barrow Island. This group includes migratory and migrant taxa, aquatic taxa and vagile taxa with flying capability at some stage of their life cycle. For example, most of the bird assemblage are migrants that regularly travel between the Pilbara mainland and offshore islands or are trans-equatorial migrants (Chevron Australia 2005).

This group also includes most of the plant species. Phytogeographically, Barrow Island is complex and particularly notable for having plants that are at their western, southern or northern limits of range. The flora is somewhat typical of the adjacent mainland in having 23% of the Pilbara region's taxa, but there are also floral affinities with the Cape Range (particularly in coastal areas) and affinities with the Kimberley region (Chevron Australia 2005; Eberhard *et al.* 2005). The only indigenous *Eucalyptus* on the island, *E. xerothermica*, is widespread across the Pilbara to Cape Range region. Some of these taxa may have persisted through glacial cycles on the island whereas others experienced a more recent influx.

CONCLUSIONS

Our comprehensive compilation of the available data on the taxa of conservation significance of Barrow Island demonstrates the very high regional, national and international significance of the biota and the ongoing importance of the island for conservation. It is commendable that the integrity of the terrestrial and aquatic biota has been maintained despite the operation of commercial oil extraction and liquified natural gas processing for over 50 years. Partly this is due to effective quarantine protocols, inspections, regular monitoring, and eradication of invasive species that have intruded sporadically.

The biota of Barrow Island is significant for the many taxa that are endemic, threatened, diminished elsewhere in their range, protected under national or international conventions, or of biogeographic interest. As such, the island represents an important conservation and scientific resource. Some of the small mammals from the island have been used to re-establish populations in other parts of their range where they have been eliminated through predation by invasive feral animals. The number of animals translocated and their successful establishment elsewhere (Table 4) suggests that these species have been stable or increasing on the island and that there has been careful assessment of animals suitable for relocation.

We described three main biogeographic patterns for the biota of the island, although these could be further delineated. There are clear biological signals of the geological, geographic and climatological history of the area through the Quaternary, and of taxonomic links dating back to the Tertiary. Changing sea levels and climatic regimes are likely to have affected local species assemblages and divergence from mainland taxa. This provides opportunities to investigate biogeographic and evolutionary processes given the overlay of these patterns and the level of endemism represented in the island's biota. The drivers and refined understanding of these patterns could be explored through additional genetic studies.

In terms of conservation co-existing with development, it is clear that the conservation program since 1910 with industrial development since the 1960s has been a success. Although the economic efficiency of the management regime has been debated in the scientific literature (Moore *et al.* 2010, 2012; Greenslade *et al.* 2013a, 2013b), the core criticism was more general as it related to appropriate use of decision modelling, with Barrow Island used as one example. Moore *et al.* (2012) conceded that there had been no contention that the management strategy for the island had been 'wrong'. Nevertheless, the island's management also has attracted media criticism and political objections (e.g. Toohey 2015), so the recent establishment of an in situ research centre along with enhanced transparency may assist in alleviating or addressing such concerns.

The extensive period of effective operation of island 'arks' such as Barrow Island is relevant to conservation management on the mainland. An increasing number of predator proof reserves are being established to protect fauna from invasive species, but the intensive management strategy imposed on Barrow Island is unlikely to be economically or logistically affordable by many other organisations. Furthermore, there is evidence of inbreeding depression in some island populations (Eldridge *et al.* 2004), a factor that requires consideration if island populations are to be utilised for translocations or for maintaining viable, genetically diverse populations on the mainland in predator- (and small-mammal) proof, enclosed reserves over the long-term. Species in enclosed protected areas will still require intensive population management including genetic evaluation and manipulation. Society should be informed of the opportunity costs or tradeoffs and limitations of conservation choices focused on ecosystems, species, populations or DNA. Preservation of genetic diversity,

behavioural characteristics and species interactions requires not only captive individuals but conservation of populations, habitats and viable ecosystems (Godden & Skellern 2006). An integrated framework with collaborative partnerships across government, research, industry and conservation organisations will be essential to achieve this.

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APPENDIX 1 TABLES

Table 1

Fauna species on Barrow Island of conservation significance (from Sedgwick 1978; Chevron Australia 2005; Humphreys *et al.* 2013; EPBC Act list 21–24 August 2018; Nature-Map (WA Department of Parks and Wildlife) search 22/2018).

Scientific name (Common name)	Significant bird population	Island endemic subspecies	State threatened/priority	Nationally threatened	IUCN Red List	Migratory - EPBC	Migratory - Bonn	Migratory - CAMBA	Migratory - JAMBA	Migratory - ROKAMBA	Marine/ Cetacean	CITES Schedule
MAMMALS												
Dasyuridae												
<i>Planigale</i> sp. 1 (Westermans <i>et al.</i> 2016)												
Macropodidae												
<i>Lagorchestes conspicillatus conspicillatus</i> (Barrow Island Spectacled hare-wallaby)		subsp.	VU	VU								
<i>Osphranter robustus isabellinus</i> / syn. <i>Macropus robustus isabellinus</i> (Barrow Island Euro)		subsp.	VU	VU								
<i>Petrogale lateralis lateralis</i> (Black-flanked rock-wallaby)			EN	EN	EN							
Muridae												
<i>Hydromys chrysogaster</i> (Water rat)			P4		LC							
<i>Pseudomys nanus</i> (Western chestnut mouse)		Island form			LC							
Peramelidae												
<i>Isodon auratus barrowensis</i> (Barrow Island Golden bandicoot)		subsp.	VU	VU	VU							
Phalangeridae												
<i>Trichosurus vulpecula arnhemensis</i> (Northern brushtail possum; Kimberley)			VU									
Potoroidae												
<i>Bettongia lesueur</i> (Barrow and Boodie Islands subspecies; Barrow Island Burrowing bettong)		subsp.	CD	VU	NT							1
REPTILES												
Scincidae												
<i>Ctenotus pantherinus acripes</i> (Barrow Island leopard skink)		subsp.										
Typhlopidae												
<i>Anilius longissimus</i> (Barrow Island blind snake; stygofauna)		sp.	P2									

Table 1. (cont.)

BIRDS

Accipitridae

<i>Haliaeetus (Pontoaetus) leucogaster</i> (White-bellied sea-eagle)					LC					M	2
<i>Haliastur indus</i> (Brahminy kite)					LC					M	
<i>Pandion cristatus</i> / syn. <i>Pandion haliaetus</i> (Osprey)	IA				LC	MI	X			M	2

Apodidae

<i>Apus (Apus) pacificus</i> (Fork-tailed swift)	IA				LC	MI		X	X	X	M
<i>Hirundapus caudacutus</i> (Spine-tailed swift, White-throated needletail)	IA				LC	MI		X	X	X	M

Ardeidae

<i>Ardea modesta</i> / syn. <i>Ardea alba</i> (Great egret, Eastern great egret)					LC						M
<i>Egretta garzetta</i> (Little egret)					LC						M
<i>Egretta sacra</i> / syn. <i>Ardea sacra</i> (Eastern reef egret)					LC						M

Burhinidae

<i>Esacus magirostris</i> / <i>E. neglectus</i> (Beach Stone-curlew)					NT						M
--	--	--	--	--	----	--	--	--	--	--	---

Campephagidae

<i>Coracina novaehollandiae</i> (Black-faced cuckoo-shrike)					LC						M
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Charadriidae

<i>Charadrius (Charadrius) leschenaultii</i> (Greater sand plover)	b, c, i	IA, VU	VU		LC	MI	X	X	X	X	
Vulnerable in WA at subsp. level											
<i>Charadrius (Charadrius) mongolus</i> (Lesser sand plover, Mongolian plover)	c, i	IA, EN	EN		LC	MI	X	X	X	X	M
<i>Charadrius (Charadrius) ruficapillus</i> (Red-capped plover)					LC						M
<i>Charadrius (Eupoda) veredus</i> (Oriental plover)		IA			LC	MI	X	X	X	X	M
<i>Pluvialis fulva</i> (Pacific golden plover)		IA			LC	MI	X	X	X	X	M
<i>Pluvialis squatarola</i> (Grey plover)		IA			LC	MI	X	X	X	X	M

Cuculidae

<i>Cacomantis pallidus</i> / syn. <i>Cuculus pallidus</i> (Pallid cuckoo)											M
<i>Cuculus optatus</i> / syn. <i>C. saturatus</i> (Oriental cuckoo)		IA			LC	MI			X	X	M

Diomedidae

<i>Thalassarche chlororhynchos</i> / syn. <i>Diomedea chlororhynchos</i> (Atlantic Yellow-nosed albatross)		IA, VU			EN	MI	X				M
--	--	--------	--	--	----	----	---	--	--	--	---

Falconidae

<i>Falco cenchroides</i> (Nankeen Kestrel)					LC						M
--	--	--	--	--	----	--	--	--	--	--	---

Fregatidae

<i>Fregata ariel</i> (Lesser frigatebird)		IA			LC	MI		X	X	X	M
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Glareolidae

<i>Glareola maldivarum</i> (Oriental pratincole)		IA			LC	MI		X	X	X	M
<i>Stiltia isabella</i> (Australian pratincole)					LC						M

Haematopodidae

<i>Haematopus fuliginosus</i> (Sooty oystercatcher)	j				LC						
---	---	--	--	--	----	--	--	--	--	--	--

Halcyonidae*Todiramphus sanctus* (Sacred kingfisher)

LC

M

Hirundinidae*Hirundo neoxena* (Welcome swallow)

LC

M

Hirundo rustica (Barn swallow)

IA

LC

MI

X

X

X

M

Petrochelidon nigricans / syn. *Hirundo nigricans* (Tree martin)

LC

M

Hydrobatidae*Oceanites oceanicus* (Wilson's storm petrel)

IA

LC

MI

X

M

Laridae*Anous tenuirostris* (Lesser noddy)

LC

M

Chlidonias leucopterus/ syn. *Chlidonias leucoptera* (White-winged black tern)

IA

LC

MI

X

X

X

M

Chroicocephalus novaehollandiae / syn. *Larus novaehollandiae* (Silver Gull)

LC

M

Gelochelidon nilotica (Gull-billed tern)

IA

LC

MI

X

M

Hydroprogne caspia / syn. *Sterna caspia* (Caspian tern)

IA

LC

MI

X

M

Onychoprion anaethetus / syn. *Sterna anaethetus* (Bridled tern)

i?

IA

LC

MI

X

X

M

Sterna dougallii (Roseate tern)

i?

IA

LC

MI

X

X

M

Sterna hirundo (Common tern)

IA

LC

MI

X

X

X

M

Sternula albifrons / syn. *Sterna albifrons* (Little tern)

IA

LC

MI

X

X

X

X

M

Sternula nereis (Fairy tern)

h

VU

VU

VU

M

Thalasseus bengalensis/ syn. *Sterna bengalensis* (Lesser crested tern)

LC

M

Thalasseus bergii / syn. *Sterna bergii* (Crested tern)

IA

LC

MI

X

M

Maluridae*Malurus leucopterus edouardi* (Barrow Island black and white fairy wren)

a

ssp.

VU

VU

Meropidae*Merops ornatus* (Rainbow bee-eater)

LC

M

Motacillidae*Anthus novaeseelandiae* / syn. *A. australis* (Australasian pipit, Richard's pipit, Australian pipit)

LC

M

Procellariidae*Ardenna pacifica* / syn. *Puffinus pacificus* (Wedge-tailed shearwater)

IA

LC

MI

X

M

Puffinus huttoni (Hutton's shearwater)

EN

EN

M

Scolopacidae*Actitis hypoleucos*/ syn. *Tringa hypoleucos* (Common sandpiper)

IA

LC

MI

X

X

X

X

M

Arenaria interpres (Ruddy turnstone)

b, c, f

IA

LC

MI

X

X

X

X

M

Calidris acuminata (Sharp-tailed sandpiper)

IA

LC

MI

X

X

X

X

M

Calidris alba (Sanderling)

i

IA

LC

MI

X

X

X

X

M

Calidris canutus (Red knot; also vulnerable subsp. in WA)

IA, VU

EN

NT

MI

X

X

X

X

M

Calidris ferruginea (Curlew sandpiper)

IA, VU

CR

NT

MI

X

X

X

X

M

Calidris ruficollis (Red-necked stint)

b, c, d, e

IA

NT

MI

X

X

X

X

M

Table 1. (cont.)

<i>Calidris tenuirostris</i> (Great knot)		IA, VU	CR	EN	MI	X	X	X	X	M	
<i>Limosa lapponica</i> (Bar-tailed godwit)	c	IA		NT	MI	X	X	X	X	M	
<i>Limosa lapponica menzbieri</i> is VU in WA and CR nationally		VU	CR								
<i>Limosa limosa</i> (Black-tailed godwit)		IA		NT	MI	X	X	X	X	M	
<i>Numenius madagascariensis</i> (Eastern curlew)		IA, VU	CR	EN	MI	X	X	X	X	M	
<i>Numenius minutus</i> (Little curlew)		IA		LC	MI	X	X	X	X	M	
<i>Numenius phaeopus</i> (Whimbrel)		IA		LC	MI	X	X	X	X	M	
<i>Tringa brevipes</i> (Grey-tailed tattler)	b, c, g	IA, P4		NT	MI	X	X	X	X	M	
<i>Tringa glareola</i> (Wood sandpiper)		IA		LC	MI	X	X	X	X	M	
<i>Tringa nebularia</i> (Common greenshank)	c	IA		LC	MI	X	X	X	X	M	
<i>Tringa stagnatilis</i> (Marsh sandpiper)		IA		LC	MI	X	X	X	X	M	
<i>Xenus cinereus</i> / syn. <i>Tringa terek</i> (Terek sandpiper)		IA		LC	MI	X	X	X	X	M	
Sulidae											
<i>Sula dactylatra</i> ssp. <i>bedouti</i> (Masked booby)		IA		LC	MI			X	X	M	
<i>Sula leucogaster</i> (Brown booby)		IA		LC	MI		X	X	X	M	
Otididae											
<i>Ardeotis australis</i> (Australian bustard)				LC							2
FISH (STYGOFUNA)											
Eleotridae											
<i>Milyeringa justitia</i> (Barrow cave gudgeon)—listed nationally and internationally as <i>M. veritas</i> from which it was separated taxonomically in 2013	sp.	VU	VU	DD							
Synbranchidae											
<i>Ophisternon candidum</i> (Blind cave eel)		VU	VU	DD							
MARINE VERTEBRATES											
Balaenidae											
<i>Eubalaena australis</i> (Southern right whale)		VU	EN	LC	MI	X				C	1
Balaenopteridae											
<i>Balaenoptera acutorostrata</i> (Minke whale)				LC						C	1, 2
<i>Balaenoptera borealis</i> (Sei whale)		EN	VU	EN	MI	X				C	1
<i>Balaenoptera edeni</i> (Bryde's whale)				LC	MI	X				C	1
<i>Balaenoptera musculus</i> (Blue whale)		EN	EN	EN	MI	X				C	1
<i>Balaenoptera physalus</i> (Fin whale)		EN	VU	EN	MI	X				C	1
<i>Megaptera novaeangliae</i> (Humpback whale)		CD	VU	LC	MI	X				C	1
Cheloniidae											
<i>Caretta caretta</i> (Loggerhead turtle)		EN	EN	VU	MI	X				M	1
<i>Chelonia mydas</i> (Green turtle)		VU	VU	EN	MI	X				M	1
<i>Eretmochelys imbricata</i> (Hawksbill turtle)		VU	VU	CR	MI	X				M	1
<i>Lepidochelys olivacea</i> (Olive ridley turtle, Pacific ridley turtle)		EN	EN	VU	MI	X				M	1
<i>Natator depressus</i> (Flatback turtle)		VU	VU	DD	MI	X				M	1

Delphinidae

<i>Delphinus delphis</i> (Common dolphin)					LC		C	2
<i>Feresa attenuata</i> (Pygmy killer whale)					DD		C	2
<i>Globicephala macrorhynchus</i> (Short-finned pilot whale)					DD		C	2
<i>Globicephala melas</i> (Long-finned pilot whale)					DD		C	2
<i>Grampus griseus</i> (Risso's dolphin)					LC		C	2
<i>Lagenodelphis hosei</i> (Fraser's dolphin)					LC		C	2
<i>Lagenorhynchus obscurus</i> (Dusky dolphin)					DD	MI	X	2
<i>Lissodelphis peronii</i> (Southern right whale dolphin)					DD		C	2
<i>Orcaella heinsohni</i> / syn. <i>O. brevirostris</i> (Australian Snubfin dolphin / Irrawaddy dolphin)	P4				VU	MI	X	1
<i>Orcinus orca</i> (Killer whale)					DD	MI	X	2
<i>Peponocephala electra</i> (Melon-headed whale)					LC		C	2
<i>Pseudorca crassidens</i> (False killer whale)					DD		C	2
<i>Sousa sahulensis</i> / syn. <i>S. chinensis</i> (Indo-Pacific humpback dolphin)	P4				VU	MI	X	1
<i>Stenella attenuata</i> (eastern tropical Pacific population, Southeast Asian populations; Pantropical spotted dolphin)					LC	MI	X	2
<i>Stenella coeruleoalba</i> (Striped dolphin)					LC		C	2
<i>Stenella longirostris</i> (Long-snouted Spinner dolphin)	P4				DD		C	2
<i>Steno bredanensis</i> (Rough-toothed dolphin)					LC		C	2
<i>Tursiops aduncus</i> (Spotted bottlenose dolphin, Indo-pacific Bottlenose Dolphin)					DD	MI	X	2
<i>Tursiops truncatus s. str.</i> (Bottlenose dolphin)					LC		C	2

Dermochelyidae

<i>Dermochelys coriacea</i> (Leatherback turtle, Leathery turtle)	VU	EN	VU	MI	X		M	1
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Dugongidae

<i>Dugong dugon</i> (Dugong)	OS		VU	MI	X		M	1
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Elapidae (Sea snakes)

<i>Aipysurus apraefrontalis</i> (Short-nosed sea snake)	CR	CR	CR				M	
<i>Aipysurus duboisii</i> (Dubois' seasnake, Reef Shallows Sea Snake)			LC				M	
<i>Aipysurus eydouxii</i> (Spine-tailed sea snake, Stagger-banded sea snake)			LC				M	
<i>Aipysurus foliosquama</i> (Leaf-scaled sea snake)	CR	CR	CR				M	
<i>Aipysurus laevis</i> (Olive sea snake, Golden sea snake)			LC				M	
<i>Emydocephalus annulatus</i> (Turtle-headed sea snake)			LC				M	
<i>Ephalophis greyi</i> (North-western mangrove sea snake)			LC				M	
<i>Hydrophis czeblukovi</i> (Fine-spined sea snake)			DD				M	
<i>Hydrophis elegans</i> (Elegant sea snake, Bar-bellied sea snake)			LC				M	
<i>Hydrophis kingii</i> / syn. <i>Disteira kingii</i> (Spectacled sea snake)			LC				M	
<i>Hydrophis major</i> / syn. <i>Disteira major</i> (Olive-headed sea snake)			LC				M	
<i>Hydrophis</i> sp. / syn. <i>H. ornatus</i> (Ornate reef sea snake)			LC				M	
<i>Hydrophis peronii</i> / syn. <i>Acalyptophis peronii</i> (Horned sea snake, Spiny-headed Sea snake)			LC				M	
<i>Hydrophis platurus</i> / syn. <i>Pelamis platurus</i> (Yellow-bellied sea snake)			LC				M	
<i>Hydrophis stokesii</i> / syn. <i>Astrotia stokesii</i> (Stokes' sea snake)			LC				M	

Table 1. (cont.)

Lamnidae							
<i>Carcharodon carcharias</i> (Great white shark)	VU, Prf	VU	VU	MI	X		2
Odontaspidae							
<i>Carcharias taurus</i> (Grey nurse shark – west coast population)	VU	VU	VU				
Kogiidae							
<i>Kogia breviceps</i> (Pygmy sperm whale)			DD			C	2
<i>Kogia sima</i> / syn. <i>K. simus</i> (Dwarf sperm whale)			DD			C	2
Physeteridae							
<i>Physeter macrocephalus</i> (Sperm whale)	VU		VU	MI	X	C	1
Rhincodontidae							
<i>Rhincodon typus</i> (Whale shark)	OS, Prf	VU	EN	MI	X		2
Serranidae							
<i>Epinephelus tukula</i> (Potato cod, Potato rockcod)	Prf		LC				
Solenostomidae (Ghost pipefish)							
<i>Solenostomus cyanopterus</i> (Blue-finned ghost pipefish, Robust ghost pipefish)			LC			M	
Syngnathidae							
<i>Bulbonaricus brauni</i> (Braun's pughead pipefish, Pug-headed pipefish)			LC			M	
<i>Campichthys tricarinatus</i> (Three-keel pipefish)			DD			M	
<i>Choeroichthys brachysoma</i> (Short-bodied pipefish)			LC			M	
<i>Choeroichthys latispinosus</i> (Murion Island pipefish)			DD			M	
<i>Choeroichthys suillus</i> (Pig-snouted pipefish)			LC			M	
<i>Doryrhamphus janssi</i> (Cleaner pipefish, Janss' pipefish)			LC			M	
<i>Festucalex scalaris</i> (Ladder pipefish)			LC			M	
<i>Filicampus tigris</i> (Tiger pipefish)			LC			M	
<i>Halicampus brocki</i> (Brock's pipefish)			LC			M	
<i>Halicampus grayi</i> (Mud pipefish)			LC			M	
<i>Halicampus nitidus</i> (Glittering pipefish)			LC			M	
<i>Halicampus spinirostris</i> (Spiny-snout pipefish)			LC			M	
<i>Haliichthys taeniophora</i> (Ribbened sea dragon)			LC			M	
<i>Hippichthys penicillus</i> (Beady pipefish, steep-nosed pipefish)			LC			M	
<i>Hippocampus angustus</i> (Narrow-bellied seahorse)			LC			M	2
<i>Hippocampus histrix</i> (Spiny seahorse)			VU			M	2
<i>Hippocampus kuda</i> (Spotted seahorse, Yellow seahorse, Estuary seahorse)			VU			M	2
<i>Micrognathus micronotopterus</i> (Tidepool pipefish)			LC			M	
<i>Phoxocampus belcheri</i> (Black rock pipefish)			LC			M	
<i>Phycodurus eques</i> (Leafy seadragon)	P2, Prf		LC			M	
<i>Phyllopteryx taeniolatus</i> (Weedy or Common sea dragon)	Prf		LC			M	
<i>Syngnathoides biaculeatus</i> (Double-ended pipehorse, Alligator pipefish)			LC			M	
<i>Trachyrhamphus bicoarctatus</i> (Bentstick pipefish, short-tailed pipefish)			LC			M	
<i>Trachyrhamphus longirostris</i> (Straight stick-pipefish)			LC			M	

Ziphiidae

<i>Berardius arnuxii</i> (Arnoux's beaked whale)	DD	C	1
<i>Hyperoodon planifrons</i> (Southern bottlenose whale)	LC	C	1
<i>Indopacetus pacificus</i> / syn. <i>Mesoplodon pacificus</i> (Longman's beaked whale, Indo-pacific Beaked Whale)	DD	C	2
<i>Mesoplodon bowdoini</i> (Andrews' beaked whale)	DD	C	2
<i>Mesoplodon densirostris</i> (Blainville's beaked whale)	DD	C	2
<i>Mesoplodon grayi</i> (Gray's beaked whale)	DD	C	2
<i>Mesoplodon hectori</i> (Hector's beaked whale)	DD	C	2
<i>Mesoplodon layardii</i> (Strap-toothed beaked whale)	DD	C	2
<i>Mesoplodon mirus</i> (True's beaked whale)	DD	C	2
<i>Tasmacetus shepherdi</i> (Shepherd's beaked whale, Tasman beaked whale)	DD	C	2
<i>Ziphius cavirostris</i> (Cuvier's beaked whale, Ginkgo-toothed beaked whale)	LC	C	2

Footnotes:

Significant bird population: a – most genetically distinct race in the species (Driskell *et al.*, 2002); b – meets 1% of EAAF population threshold; c – meets staging threshold (0.25% of flyway); d – meets 1% of global population threshold (Bamford & Moro 2011); e – 2.4 % of known trans-equatorial migratory population supported seasonally; f – 5.5 % of known trans-equatorial migratory population supported seasonally; g – 6.6 % of known trans-equatorial migratory population supported seasonally; h – 8.3 % of known population; i – staging criterion of 0.25% a species population; j – significant resident site (1.1 % of known population) of northern race (*ophthalmicus*) of the species (Chevron 2005, appendix C3).

State conservation codes: CR – Critically Endangered; E – Endangered; V – Vulnerable; IA – Migratory birds protected under an international agreement; CD – Conservation dependent fauna; OS – Other specially protected fauna (*Wildlife Conservation Act 1950*); P2 – Priority species 2; Poorly known species; P4 – Priority species 4; Rare, near threatened and other species in need of monitoring; Prf – Protected fish (*Fish Resources Management Act 1994*).

Nationally threatened codes: CR – Critically Endangered; EN – Endangered; VU – Vulnerable (*Environment Protection and Biodiversity Conservation Act 1999*).

IUCN: CR – Critically Endangered; EN – Endangered; VU – Vulnerable; NT – Near Threatened; DD – Data Deficient; LC – Least Concern (IUCN 2018).

Table 2

Invertebrate taxa on Barrow Island of conservation significance.

ORDER	FAMILY	GENUS SPECIES	Endemic to Montebello/ Lowendal/ Barrow islands sand bars	Island endemic or short-range endemic	State listed species	Nationally listed species
MARINE INVERTEBRATES						
(Class Gastropoda) Hypsogastropoda	Volutidae	<i>Amoria macandrewi</i> ®	X			
TERRESTRIAL INVERTEBRATES						
Araneae (spiders)	Ammoxenidae	<i>Barrowammo waldockae</i> ®		X		
Araneae	Barychelidae	<i>Synothele butleri</i> (brush-footed trapdoor spider)®		X		
Araneae	Miturgidae	<i>Miturga serrata</i> ®		X		
Araneae	Oonopidae	<i>Orchestina 'barrow'</i> ®		X		
Araneae	Pholcidae	<i>Trichocyclus</i> sp. 1 ®		X		
Araneae	Prodidomidae	<i>Wyndura barrow</i> ®		X		
Araneae	Selenopidae	<i>Karaops burbridgei</i>		X		
Araneae	Zodariidae	<i>Spinasteron 'harveyi'</i> ®		X		
Collembola (springtail)	Entomobryidae	<i>Acanthocyrtus barrowensis</i>		X		
Collembola	Entomobryidae	<i>Drepanura liuae</i>		X		
Collembola	Entomobryidae	<i>Drepanura polychaeta</i>		X		
Collembola	Paronellidae	<i>Metacoelura majeri</i>		X?		
Diptera (flies)	Dolichopodidae	<i>Pseudoparentia niharae</i>		X		
Diptera	Dolichopodidae	<i>Thinophilus</i> sp. (female)		X		
Diptera	Dolichopodidae	<i>Teuchophorus</i> sp.		X		
Hemiptera (true bugs)	Cicadellidae:	<i>Gunawardenea linnaei</i>		X?		
Hemiptera (true bugs)	Cicadellidae	<i>Horouta darwini</i>		X		
Hymenoptera (ants)	Eulophidae	<i>Elasmus curticornis</i>		X?		
Neuroptera (lace wings)	Ascalaphidae	<i>Suhpalacsa barrowensis</i>		X?		
Polydesmida (millipede)	Paradoxosomatidae	<i>Boreohesperus dubitalis</i>		X		
Polydesmida	Haplodesmidae	<i>Genus and species indet.</i>		X		
Pseudoscorpiones (pseudoscorpions)	Garypidae	<i>Anagarypus heatwolei</i> ®		X		
Pseudoscorpiones	Garypidae	<i>Synsphyronus</i> sp. nov. 'barrow' ®		X?		
Pseudoscorpiones	Syarinidae	<i>Ideoblothrus nesotymbus</i>		X		
Pseudoscorpiones	Chthoniidae	<i>Tyrannochthonius garthhumphreysi</i>		X		
Stylommatophora (land snails)	Camaenidae	<i>Rhagada barrowensis</i>		X		
Stylommatophora	Camaenidae	<i>Rhagada plicata</i>		X		
Stylommatophora	Camaenidae	<i>Quistrachia montebelloensis</i>		X		
Scorpiones (scorpions)	Urodacidae	<i>Aops oncodactylus</i>	Endemic genus	X		
Scorpiones	Urodacidae	<i>Urodacus</i> sp. nov. 'barrow' ®		X		
Thysanoptera (thrips)	Aeolothripidae	<i>Desmothrips barrowi</i>		X?		
Thysanoptera	Phlaeothripidae	<i>Majerthrips barrowi</i>		X?		
Thysanoptera	Phlaeothripidae	<i>Senithrips psomus</i>	Endemic genus	X?		
Thysanoptera	Phlaeothripidae	<i>Jacotia rhodorchia</i>		X?		
Thysanoptera	Phlaeothripidae	<i>Podothrips barrowi</i>		X?		
Thysanoptera	Thripidae	<i>Anaphothrips barrowi</i>		X?		
Thysanoptera	Thripidae	<i>Neohydatothrips barrowi</i>		X?		

TROGLOBITIC FAUNA

Blattodea (cockroaches)	Nocticolidae	<i>Nocticola</i> sp. nov. 1 ^	X	
Spirobolida (millipede)	Trigoniulidae	<i>Speleostrophus nesiotes</i> (Barrow Island Millipede) ^®	X	VU
Schizomida (palpigrades)	Hubbardiidae	<i>Draculoides bramstokeri</i> (Barrow Island Schizomid) ^		VU
Zygentoma (silver fish)	Nicoletiidae	<i>Trinemura</i> sp. nov. 1 ^	X	
Zygentoma	Nicoletiidae	<i>Trinemura</i> sp. nov. 2 ^	X	

STYGOFAUNA

Amphipoda (sand hoppers)	Hadziidae	<i>Liagoceradocus subthalassicus</i> (Barrow Island liagoceradocus amphipod) ^	X	VU
Amphipoda	Melitidae	<i>Nedsia chevronia</i> (Chevron's freshwater amphipod (Barrow Island)	X	P2
Amphipoda	Melitidae	<i>Nedsia fragilis</i> ^	X	VU
Amphipoda	Melitidae	<i>Nedsia halletti</i>	X	
Amphipoda	Melitidae	<i>Nedsia humphreysi</i> ^	X	VU
Amphipoda	Melitidae	<i>Nedsia hurlberti</i> ^	X	VU
Amphipoda	Melitidae	<i>Nedsia macrosculptilis</i> ^	X	VU
Amphipoda	Melitidae	<i>Nedsia sculptilis</i> ^	X	VU
Amphipoda	Melitidae	<i>Nedsia stefania</i>	X	
Amphipoda	Melitidae	<i>Nedsia straskraba</i> ^	X	VU
Amphipoda	Melitidae	<i>Nedsia urifimbriata</i> ^	X	VU
Amphipoda	Bogidiellidae	<i>Bogidomma australis</i> (Barrow Island Bogidomma amphipod) ^	X	VU
Copepoda	Ameiridae	<i>Inermipes humphreysi</i>	X?	
Copepoda	Tetragonicipitidae	<i>Dussartcyclops</i> (Barrowcyclops) consensus	X?	
Copepoda	Tetragonicipitidae	<i>Phyllopodopsyllus wellsii</i>	X?	
Decapoda	Atyidae	<i>Stygiocaris stylifera</i> (Speak-beaked cave shrimp) ^		P4
Isopoda (woodlice, slaters)	Armadillidae	<i>Barrowdillo pseudopyrgoniscus</i> &	X	
Isopoda	Armadillidae	<i>Buddelundia hirsuta</i> &	X	
Isopoda	Armadillidae	<i>Buddelundia</i> sp. 2 &	X?	
Isopoda	Armadillidae	<i>Buddelundia</i> sp. 4 &	X?	
Isopoda	Armadillidae	Armadillidae genus 1 sp. 1 &	X?	
Isopoda	Armadillidae	Armadillidae genus 2 sp. 1 &	X?	
Isopoda	Armadillidae	Armadillidae genus 3 sp. 1 &	X	
Isopoda	Armadillidae	Armadillidae genus 3 sp. 2 &	X?	
Isopoda	Armadillidae	Armadillidae genus 4 sp. 2 &	X?	
Isopoda	Cirolanidae	<i>Haptolana pholeta</i> ^	X	
Thermosbaenacea	Halosbaenidae	<i>Halosbaena tulki</i> ^	X	

Data sources:

Chevron Australia (2005 p. 245 and appendix C4)[®] ;
amphipods: Bradbury & Williams (1996a, 1996b), Bradbury (2002);
millipedes: Bickel (2013) and Car *et al.* (2013);
Tyrannochthonius: Edward & Harvey (2008);
Hemiptera: Fletcher & Moir (2008), Fletcher (2009);
Collembola: Greenslade (2013), Ma *et al.* (2015, 2016);
Elasmus curticornis: Gunawardene & Taylor (2012);
Ideoblothrus nesotymbus: Harvey & Edward (2007);
Camaenid land snails: Humphreys *et al.* (2013)[^]; Johnson *et al.* (2013);
Suhpalacsa barrowensis: Judd & Perina (2013)[&]; New (1984);

Aops oncodactylus: Volschenk & Prendini (2008);
Thysanoptera from Mound & Minaei (2007), Mound & Matsumoto (2009), Pereyra & Mound (2010); and
Copepoda from Karanovic (2003), Karanovic *et al.* (2001)

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Table 3

Vascular plant species on Barrow Island of conservation significance (from Chevron Australia 2005, appendix C1; Maslin & van Leeuwen 2008; Telford *et al.* 2011; and NatureMap 2018).

Family	Scientific name	Island or short-range endemic species/ form/ variant	State priority flora	Habitat reduced by human disturbance
Amaranthaceae				
	<i>Amaranthus</i> sp. Barrow Island D200 (R.Buckley 6884) %	X		
Asteraceae				
	<i>Helichrysum oligochaetum</i>		P1	
Chenopodiaceae				
	<i>Dysphania kalpari</i> *			X
Cucurbitaceae				
	<i>Cucumis</i> sp. Barrow Island (D.W. Goodall 1264)		P2	
	<i>Cucumis variabilis</i>	X		
Euphorbiaceae				
	<i>Euphorbia</i> sp. A			X
Fabaceae				
	<i>Acacia trudgeniana</i> (dwarf form) *	X		
Malvaceae				
	<i>Abutilon otocarpum</i> #			X
	<i>Corchorus congener</i> *		P3	
	<i>Gossypium australe</i> #			X
	<i>Hibiscus sturtii</i> var. <i>platychlamys</i>			X

* Listed in Chevron (2005) as *Acacia inaequilatera* (dwarf form) and *Corchorus interstans* Halford ms

Listed in Chevron (2005) but not in Florabase (25/8/18) as present on Barrow Island

% From NatureMap query 22/8/18

Table 4

Corals of Barrow Island and Montebello Islands of international conservation significance (from Richards & Rosser 2012; status checked 1/10/18).

FAMILY	GENUS SPECIES	IUCN listing
Acroporidae	<i>Acropora aculeus</i>	VU
	<i>Acropora acuminata</i>	VU
	<i>Acropora anthocercis</i>	VU
	<i>Acropora donei</i>	VU
	<i>Acropora horrida</i>	VU
	<i>Acropora listeri</i>	VU
	<i>Acropora lovelli</i>	VU
	<i>Acropora microclados</i>	VU
	<i>Acropora palmerae</i>	VU
	<i>Acropora polystoma</i>	VU
	<i>Acropora solitaryensis</i>	VU
	<i>Acropora spicifera</i>	VU
	<i>Acropora verweyi</i>	VU
	<i>Acropora willisae</i>	VU
	<i>Isopora brueggemanni</i>	VU
	<i>Montipora crassituberculata</i>	VU
	<i>Montipora turtlensis</i>	VU
Agariciidae	<i>Pachyseris rugosa</i>	VU
	<i>Pavona decussata</i>	VU
	<i>Pavona venosa</i>	VU
Dendrophylliidae	<i>Turbinaria bifrons</i>	VU
	<i>Turbinaria mesenterina</i>	VU
	<i>Turbinaria patula</i>	VU
	<i>Turbinaria peltata</i>	VU
	<i>Turbinaria reniformis</i>	VU
Euphyllidae	<i>Euphyllia (Fimbriaphyllia) ancora</i>	VU
	<i>Galaxea astreata</i>	VU
	<i>Physogyra lichtensteini</i>	VU
Lobophylliidae	<i>Acanthastrea hemprichii</i>	VU
	<i>Lobophyllia diminuta</i>	VU
	<i>Lobophyllia flabelliformis</i>	VU
	<i>Moseleya latistellata</i>	VU
Merulinidae	<i>Caulastrea curvata</i>	VU
	<i>Echinopora ashmorensis</i>	VU
	<i>Para montastreaeasalebrosa</i> / syn.	VU
	<i>Montastrea salebrosa</i>	
	<i>Pectinia lactuca</i>	VU
	<i>Platygyrayaayamaensis</i>	VU
Poritidae	<i>Goniopora burgosi</i>	VU
	<i>Porites nigrescens</i>	VU

Table 5

Short-range endemism, affinities and vulnerability for taxa of Barrow Island.

Taxon group	Habitat preference	Vulnerability to sea level changes	Geographic affinities (+ve and -ve)	Level of endemism
Flora	Terrestrial – coastal and inland arid zone	High vulnerability	Pilbara IBRA region, plus Cape Range and Kimberley	Low. Two plant forms or variants of 406 species
Ants (Hymenoptera)	Terrestrial	High vulnerability		Low. Potentially 5 of 117 species endemic
Terrestrial mammals	Terrestrial	High vulnerability		Four subspecies and one island form endemic
Reptiles	Terrestrial	High vulnerability		None known
Reptiles	Troglobites	Low vulnerability		Endemic skink and blind snake
Fish	Stygobites	Low vulnerability	Cape Range and west Pilbara	Endemic gudgeon and short range endemic blind cave eel
Birds	Littoral or terrestrial or arboreal or migratory	High vulnerability for resident birds, low for migratory birds		Endemic subspecies. Depauperate land birds but non-migratory species assumed to be genetically distinct
Marine vertebrates	Marine to intertidal or littoral	Low vulnerability		None known
Invertebrates – Odonata, Embiidina, Isoptera, Termites	Terrestrial	High in situ, low vulnerability for vagile life stages		Low. Often are vagile species and widespread
Terrestrial invertebrates	Terrestrial moist areas or rock crevices	High vulnerability		22 endemic to island: 8 Arachnids, 2 millipedes, 3 Camaenid land snails, 1 mollusc, 1 pseudoscorpion, 5 silverfish, 3 thrips, 1 booklice, 6 Isopods
Collembola	Terrestrial or marine littoral			7 of 71 species endemic (low endemism most spp in northern Aust).
Collembola	Subterranean	Low vulnerability		1+ subterranean species endemic and 3 others potential endemics
<i>Elasmus</i> (parasitoid wasps)	Terrestrial	High vulnerability		Low. 1 of 11 species is potential endemic
Dolichopodidae (Diptera)	Terrestrial - moist areas or rock crevices	High vulnerability	Pilbara, tropical and monsoonal Australasia	Low. 1 island endemic and one short range endemic of 41 species in the Pilbara
Marine invertebrates	Marine water	Low vulnerability		One endemic to island complex
Stygofauna invertebrates	Freshwater	Low vulnerability		7 endemic <i>Nedsia</i> species, 1 endemic genus <i>Bogidomma</i>
Stygofauna invertebrates	Marine or brackish water	Low vulnerability		1 anchialinetroglobite (<i>Liagoceradocus</i>)
Invertebrates - Schizomid	Troglobytes	Low vulnerability	Cape Range	One species endemic to BI and Cape Range
Invertebrates - millipede	Troglobytes	Low vulnerability		Two short range endemic species
Invertebrates - millipede	Terrestrial (epigeal)			One endemic species
Invertebrates - scorpion	Troglobitic			One endemic which may be the most basal member of the family

Table 6

Approximate sea level depths over the last 150 000 years in the Barrow Island region and effect on its isolation from other Western Australian islands and the mainland (based on data in Grant *et al.* 2012, suppl. material).

Age (ky)	Depth * (m)	Trend	Effect on Barrow Island
Current	0	Rising	Isolated from other islands and landmasses
5	-10	Rising	Isolated from mainland but connected to Montebello Islands and Lowendal Islands
10	-28	Rising	On edge of coastal plain. Connected to coast swampy to east and north with rugged topography to NW Cape
15	-78	Rising	Midway across coastal plain. Midway across coastal plain. Connected to coast sandy desert to east and north-east. Rugged topography to NW Cape
20	-97	Rising	"
22	-110	Peak low	"
25	-104	Falling	"
29	-105	Minor fluctuations	"
30	-101	Falling	"
35	-84	Falling	"
40	-83	Fluctuations	"
60	-70	Fluctuations	"
65	-100	Peak low	"
75	-70	Falling with fluctuations	"
85	-36	Peak high	Midway across coastal plain. Connected to coast wetlands to east and north with some water barriers. Rugged topography to NW Cape
87.5	-73	Peak low	"
106.5	-30	Peak high	"
110	-50	Peak low	"
119	-20	Falling	On edge of coastal plain
122.5	-10	Falling	Isolated from mainland but connected to Montebello Islands and Lowendal Islands
128	+7	Peak high	Partial Inundation of island. Isolated from other islands and landmasses
130	-10	Rising	Isolated from mainland but connected to Montebello Islands and Lowendal Islands
132	-20	Rising	On edge of coastal plain
133	-60	Rising	Midway across coastal plain. Connected to coast sandy desert to east, wetlands to north east, with rugged topography to NW Cape
140	-90	Rising	"
150	-90	Minor fluctuations (<5	"

* Modelled relative sea level (RSL ProbMax) with 2 standard errors approximately +/- 3.5 m

Appendix 2. Taxa referred to in main text and Appendix 1.

Class or above	Order	Family	genus & species
PLANTS – ANGIOSPERMS			
		Amaranthaceae	
			<i>Amaranthus</i> sp. Barrow Island (R. Buckley 6884) in Chevron Australia (2005)
		Asteraceae	
			<i>Helichrysum oligochaetum</i> F. Muell.
		Chenopodiaceae	
			<i>Dysphania kalpari</i> Paul G. Wilson
		Cucurbitaceae	
			<i>Cucumis</i> sp. Barrow Island (D.W. Goodall 1264)
			<i>Cucumis variabilis</i> P. Sebastian & I. Telford
		Euphorbiaceae	
			<i>Euphorbia</i> sp. A in Chevron Australia (2005)
		Fabaceae	
			<i>Acacia trudgeniana</i> Maslin (dwarf form) in Chevron Australia (2005)
		Malvaceae	
			<i>Abutilon otocarpum</i> F. Muell.
			<i>Corchorus congener</i> Halford
			<i>Gossypium australe</i> F. Muell.
			<i>Hibiscus sturtii</i> var. <i>platychlamys</i> Benth.
		Myrtaceae	
			<i>Eucalyptus xerothermica</i> L.A.S. Johnson & K.D. Hill
VERTEBRATE ANIMALS (Phylum Chordata, Subphylum Vertebrata)			
TERRESTRIAL MAMMALS (Class Mammalia)			
Subclass Marsupalia			
	Order Dasyuromorphia		
		Dasyuridae	
			<i>Planigale</i> sp. 1 in Westermans <i>et al.</i> (2016)
	Order Diprotodontia		
		Macropodidae	
			<i>Lagorchestes conspicillatus</i> Gould, 1842
			<i>Lagorchestes conspicillatus conspicillatus</i> Gould, 1842
			<i>Osphranter robustus isabellinus</i> (Gould, 1842) [syn. <i>Macropus robustus isabellinus</i> in Chevron Australia (2005)]
			<i>Petrogale lateralis lateralis</i> Gould, 1842
		Phalangeridae	
			<i>Trichosurus vulpecula arnhemensis</i> Collett, 1897
		Potoroidae	
			<i>Bettongia lesueur</i> (Quoy & Gaimard, 1824)
	Order Peramelemorphia		
		Peramelidae	
			<i>Isodon auratus</i> (Ramsay, 1887)
			<i>Isodon auratus barrowensis</i> (Thomas, 1901)
Subclass Eutheria			
	Order Rodentia		
		Muridae	
			<i>Hydromys chrysogaster</i> Geoffroy, 1804
			<i>Mus musculus</i> Linnaeus, 1758 (exotic species)
			<i>Pseudomys nanus</i> (Gould, 1858)
			<i>Rattus rattus</i> (Linnaeus, 1758) (exotic species)
MARINE MAMMALS			
	Order Cetacea		
		Balaenidae	
			<i>Eubalaena australis</i> (Desmoulins, 1822)

Appendix 2. (cont.)

Balaenopteridae

- Balaenoptera acutorostrata* Lacépède, 1804
- Balaenoptera borealis* Lesson, 1828
- Balaenoptera edeni* Anderson, 1878
- Balaenoptera musculus* (Linnaeus, 1758)
- Balaenoptera physalus* (Linnaeus, 1758)
- Megaptera novaeangliae* (Borowski, 1781)

Delphinidae

- Delphinus delphis* Linnaeus, 1758
- Feresa attenuata* J.E. Gray, 1874
- Globicephala macrorhynchus* J.E. Gray, 1846
- Globicephala melas* (Traill, 1809)
- Grampus griseus* (Cuvier, 1812)
- Lagenodelphis hosei* Fraser, 1956
- Lagenorhynchus obscurus* (J.E. Gray, 1828)
- Lissodelphis peronii* (Lacépède, 1804)
- Orcaella heinsohni* Beasley, Robertson & Arnold, 2005 [syn. *O. brevirostris* in Chevron Australia (2005)]
- Orcinus orca* (Linnaeus, 1758)
- Peponocephala electra* (J.E. Gray, 1846)
- Pseudorca crassidens* (Owen, 1846)
- Sousa sahulensis* Jefferson & Rosenbaum, 2014 [syn. *S. chinensis* in Chevron Australia (2005)]
- Stenella attenuata* (J.E. Gray, 1846)
- Stenella coeruleoalba* (Meyen, 1833)
- Stenella longirostris* (J.E. Gray, 1828)
- Steno bredanensis* (Lesson, 1828)
- Tursiops aduncus* (Ehrenberg, 1832)
- Tursiops truncatus* (Montagu, 1821)

Dugongidae

- Dugong dugon* (P.L.S. Müller, 1776)

Kogiidae

- Kogia breviceps* Duvernoy, 1851
- Kogia sima* (Owen, 1866) [syn. *Kogia simus* in Chevron Australia (2005), SPRAT database 2018]

Physeteridae

- Physeter macrocephalus* Linnaeus, 1758

Ziphiidae

- Berardius arnuxii* Duvernoy, 1851
- Hyperoodon planifrons* Flower, 1882
- Indopacetus pacificus* (Longman, 1926) [syn. *Mesoplodon pacificus* in Chevron Australia (2005)]
- Mesoplodon bowdoini* Andrews, 1908
- Mesoplodon densirostris* (Blainville, 1817)
- Mesoplodon grayi* Von Haast, 1876
- Mesoplodon hectori* (J.E. Gray, 1871)
- Mesoplodon layardii* (J.E. Gray, 1865)
- Mesoplodon mirus* True, 1913
- Tasmacetus shepherdi* Oliver, 1937
- Ziphius cavirostris* Cuvier, 1823

BIRDS (Class Aves)

Order Apodiformes

Apodidae

- Apus (Apus) pacificus* (Latham, 1801)
- Hirundapus caudacutus* (Latham, 1801)

Order Charadriiformes

Burhinidae

- Esacus magnirostris* Vieillot, 1818 [syn. *Esacus neglectus* in Chevron Australia (2005)]

Charadriidae

- Charadrius (Charadrius) leschenaultii* Lesson, 1826
- Charadrius (Charadrius) mongolus* Pallas, 1776
- Charadrius (Charadrius) ruficapillus* Temminck, 1821
- Charadrius (Eupoda) veredus* Gould, 1848

Pluvialis fulva (Gmelin, 1789)

Pluvialis squatarola (Linnaeus, 1758)

Glareolidae

Glareola (Glareola) maldivarum J.R. Forster, 1795

Stiltia isabella (Vieillot, 1816)

Haematopodidae

Haematopus fuliginosus Gould, 1845

Haematopus fuliginosus ophthalmicus Castelnau & Ramsay, 1877

Laridae

Anous tenuirostris (Temminck, 1823)

Chlidonias (Chlidonias) leucopterus (Temminck, 1815) [syn. *Chlidonias leucoptera* in Chevron Australia (2005)]

Chroicocephalus novaehollandiae (Stephens, 1826) [syn. *Larus novaehollandiae* in Chevron Australia (2005), NatureMap 2018]

Gelochelidon nilotica (Gmelin, 1789)

Hydroprogne caspia (Pallas, 1770) [syn. *Sterna caspia* in Chevron Australia (2005)]

Onychoprion anaethetus (Scopoli, 1786) [syn. *Sterna anaethetus* in Chevron Australia (2005)]

Sterna (Sterna) dougallii Montagu, 1813

Sterna (Sterna) hirundo Linnaeus, 1758

Sternula albifrons (Pallas, 1764) [syn. *Sterna albifrons* in Chevron Australia (2005)]

Sterna nereis Gould, 1843

Sternula nereis (Gould, 1843) [syn. *Sterna nereis* in Chevron Australia (2005)]

Thalasseus bengalensis (Lesson, 1831) [syn. *Sterna bengalensis* in Chevron Australia (2005)]

Thalasseus bergii (Lichtenstein, 1823) [syn. *Sterna bergii* in Chevron Australia (2005)]

Scolopacidae

Actitis hypoleucos (Linnaeus, 1758) [syn. *Tringa hypoleucos* in Chevron Australia (2005)]

Arenaria interpres (Linnaeus, 1758)

Calidris (Erolia) acuminata (Horsfield, 1821)

Calidris (Crocethia) alba (Pallas, 1764)

Calidris (Calidris) canutus (Linnaeus, 1758)

Calidris (Erolia) ferruginea (Pontoppidan, 1763)

Calidris (Ereunetes) ruficollis (Pallas, 1776)

Calidris (Calidris) tenuirostris (Horsfield, 1821)

Limosa lapponica (Linnaeus, 1758)

Limosa lapponica menzbieri Partenko, 1936

Limosa limosa (Linnaeus, 1758)

Numenius (Numenius) madagascariensis (Linnaeus, 1766)

Numenius (Mesoscolopax) minutus Gould, 1841 [syn. *Numenius minutes* in Chevron Australia (2005)]

Numenius (Phaeopus) phaeopus (Linnaeus, 1758)

Tringa (Heteroscelus) brevipes (Vieillot, 1816)

Tringa (Rhyacophilus) glareola Linnaeus, 1758

Tringa (Glottis) nebularia (Gunnerus, 1767)

Tringa (Rhyacophilus) stagnatilis (Bechstein, 1803)

Xenus cinereus (Güldenstädt, 1775) [syn. *Tringa terek* in Chevron Australia (2005)]

Order Ciconiiformes

Ardeidae

Ardea (Casmerodius) modesta J.E. Gray, 1831 [syn. *Ardea alba* in Chevron Australia (2005)]

Egretta garzetta (Linnaeus, 1766)

Egretta sacra (Gmelin, 1789) [syn. *Ardea sacra* in Chevron Australia (2005)]

Order Columbiformes

Columbidae

Geopelia humeralis (Temminck, 1821)

Order Coraciiformes

Halcyonidae

Todiramphus (Todiramphus) sanctus (Vigors & Horsfield, 1827)

Meropidae

Merops (Merops) ornatus Latham, 1801

Order Cuculiformes

Cuculidae

Cacomantis (Vidgenia) pallidus (Latham, 1801) [syn. *Cuculus pallidus* in Chevron Australia (2005)]

Cuculus (Cuculus) optatus Gould, 1845 [syn. *C. saturatus* in Chevron Australia (2005)]

Appendix 2. (cont.)

Order Falconiformes

Accipitridae

Haliaeetus (Pontoaetus) leucogaster (Gmelin, 1788)

Haliastur indus (Boddaert, 1783)

Pandion cristatus (Vieillot, 1816) [syn. *Pandion haliaetus* in Chevron Australia (2005)]

Falconidae

Falco (Tinnunculus) cenchroides Vigors & Horsfield, 1827

Order Gruiformes

Otididae

Ardeotis australis (J.E. Gray, 1829)

Order Passeriformes

Campephagidae

Coracina (Coracina) novaehollandiae (Gmelin, 1789)

Hirundinidae

Hirundo (Hirundo) neoxena neoxena Gould, 1843

Hirundo (Hirundo) rustica Linnaeus, 1758

Petrochelidon (Hylochelidon) nigricans (Vieillot, 1817) [syn. *Hirundo nigricans* in Chevron Australia (2005)]

Maluridae

Malurus (Musciparus) leucopterus edouardi A.J. Campbell, 1901

Megaluridae

Eremiornis carteri North, 1900

Meliphagidae

Gavicalis virescens (Vieillot, 1817)

Motacillidae

Anthus (Anthus) novaeseelandiae (Gmelin, 1789) [syn. *A. australis* in NatureMap 2018]

Order Pelecaniformes

Fregatidae

Fregata ariel (G.R. Gray, 1845)

Sulidae

Sula dactylatra bedouti Mathews, 1913

Sula leucogaster (Boddaert, 1783)

Order Procellariiformes

Diomedidae

Thalassarche chlororhynchos (Gmelin) [syn. *Diomedea chlororhynchos* in Chevron Australia (2005)]

Oceanitidae

Oceanites oceanicus (Kuhl, 1820)

Procellariidae

Ardeanna pacifica (Gmelin, 1789) [syn. *Puffinus pacificus* in Chevron Australia (2005)]

Puffinus (Puffinus) huttoni Mathews, 1912

FISH

MARINE FISH

Order Lamniformes

Lamnidae

Carcharodon carcharias (Linnaeus, 1758)

Odontaspidae

Carcharias taurus Rafinesque, 1810

Order Orectolobiformes

Rhincodontidae

Rhincodon typus Smith, 1828

Order Perciformes

Serranidae

Epinephelus tukula Morgans, 1959

Order Syngnathiformes

Solenostomidae

Solenostomus cyanopterus Bleeker, 1854

Syngnathidae

Bulbonaricus brauni (Dawson & Allen, 1978)

Campichthys tricarinatus Dawson, 1977

Choeroichthys brachysoma (Bleeker, 1855)

Choeroichthys latispinosus Dawson, 1978
Choeroichthys suillus Whitley, 1951
Doryrhamphus janssi (Herald & Randall, 1972)
Festucalex scalaris (Günther, 1870)
Filicampus tigris (Castelnau, 1879)
Halicampus brocki (Herald, 1953)
Halicampus grayi Kaup, 1856
Halicampus nitidus (Günther, 1873)
Halicampus spinirostris (Dawson & Allen, 1981)
Haliichthys taeniophora Gray, 1859
Hippichthys penicillus (Cantor, 1849)
Hippocampus angustus Günther, 1870
Hippocampus histrix Kaup, 1856
Hippocampus kuda Bleeker, 1852
Micrognathus micronotopterus (Fowler, 1938)
Phoxocampus belcheri (Kaup, 1856)
Phycodurus eques (Günther, 1865)
Phyllopteryx taeniolatus (Lacépède, 1804)
Syngnathoides biaculeatus (Bloch, 1785)
Trachyrhamphus bicoarctatus (Bleeker, 1857)
Trachyrhamphus longirostris Kaup, 1856

STYGIAL FISH

Order Perciformes

Eleotridae

Milyeringa justitia Larson & Foster, 2013

Order Synbranchiformes

Synbranchidae

Ophisternon candidum (Mees, 1962)

REPTILES (Class Reptilia)

TERRESTRIAL LIZARDS

Order Squamata

Scincidae

Ctenotus pantherinus acripes Storr, 1975

STYGIAL SNAKES

Order Squamata

Typhlopidae

Anilius longissimus (Aplin, 1998) [syn. *Ramphotyphlops longissimus* in Aplin (1998)]

MARINE SNAKES

Order Squamata

Elapidae

Aipysurus apraefrontalis Smith, 1926
Aipysurus duboisii Bavay, 1869
Aipysurus eydouxii Gray, 1849
Aipysurus foliosquama (Smith, 1926)
Aipysurus laevis Lacépède, 1804
Emydocephalus annulatus Krefft, 1869
Ephalophis greyi Smith, 1931
Hydrophis czeblukovi (Kharin, 1984)
Hydrophis elegans (Gray, 1842)
Hydrophis kingii (Boulenger, 1896) [syn. *Disteira kingii* in Chevron Australia (2005), SPRAT database 2018]
Hydrophis major (Shaw, 1802) [syn. *Disteira major* in Chevron Australia (2005), SPRAT database 2018]
Hydrophis peronii (Duméril, 1853) [syn. *Acalyptophis peronii* in Chevron Australia (2005), SPRAT database 2018]
Hydrophis platurus (Linnaeus, 1766) [syn. *Pelamis platurus* in Chevron Australia (2005), SPRAT database 2018]
Hydrophis stokesii (Gray, 1846) [syn. *Astrotia stokesii* in Chevron Australia (2005), SPRAT database 2018]
Hydrophis Sonnini & Latreille sp. [syn. *H. ornatus* in Chevron Australia (2005), SPRAT database 2018, NatureMap 2018]

TURTLES

Order Testudines

Cheloniidae

Caretta caretta (Linnaeus, 1758)
Chelonia mydas (Linnaeus, 1758)

Appendix 2. (cont.)

Eretmochelys imbricata (Linnaeus, 1766)
Lepidochelys olivacea (Eschscholtz, 1829)
Natator depressus (Garman, 1880)

Dermochelyidae

Dermochelys coriacea (Vandelli, 1761)

INVERTEBRATES

MARINE INVERTEBRATES

GASTROPODS (Phylum Mollusca, Class Gastropoda)

Order Cerithimorpha

Cerithiidae

Rhinoclavis sp. Swainson, 1840

Order Hypsogastropoda

Conidae

Conus sp. Linnaeus, 1758

Volutidae

Amoria macandrewi (Sowerby, 1887)

BIVALVES (Phylum Mollusca, Class Bivalvia)

Order Mytilida

Mytilidae

Modiolus sp. Lamarck, 1799

CORALS (Phylum Cnidaria, Class Anthozoa)

Order Scleractinia

Acroporidae

Acropora aculeus (Dana, 1846)
Acropora acuminata (Verrill, 1864)
Acropora anthocercis (Brook, 1893)
Acropora donei Veron & Wallace, 1984
Acropora horrida (Dana, 1846)
Acropora listeri (Brook, 1893)
Acropora lovelli Veron & Wallace, 1984
Acropora microclados (Ehrenberg, 1834)
Acropora palmerae Wells, 1954
Acropora polystoma (Brook, 1891)
Acropora solitaryensis Veron & Wallace, 1984
Acropora spicifera (Dana, 1846)
Acropora verweyi Veron & Wallace, 1984
Acropora willisae Veron & Wallace, 1984
Isopora brueggemanni (Brook, 1893)
Montipora crassituberculata Bernard, 1897
Montipora turtlensis Veron & Wallace, 1984

Agariciidae

Pachyseris rugosa (Lamarck, 1801)
Pavona decussata (Dana, 1846)
Pavona venosa (Ehrenberg, 1834)

Dendrophylliidae

Turbinaria bifrons Brüggemann, 1877
Turbinaria mesenterina (Lamarck, 1816)
Turbinaria patula (Dana, 1846)
Turbinaria peltata (Esper, 1794)
Turbinaria reniformis Bernard, 1896

Euphylliidae

Euphyllia (Fimbriaphyllia) ancora Veron & Pichon, 1980
Galaxea astreata Lamarck, 1816
Physogyra lichtensteini (Milne Edwards & Haime, 1851)

Lobophylliidae

Acanthastrea hemprichii (Ehrenberg, 1834)
Lobophyllia diminuta Veron, 1985
Lobophyllia flabelliformis Veron, 2000
Moseleya latistellata Quelch, 1884

Merulinidae

- Caulastraea curvata* Wijsmann-Best, 1972
Echinopora ashmorensis Veron, 1990
Paramontastraea salebroso (Nemenzo, 1959)
Pectinia lactuca (Pallas, 1766)
Platygyra yaeyamaensis (Eguchi & Shirai, 1977)

Poritidae

- Goniopora burgosi* Nemenzo, 1955
Porites nigrescens Dana, 1846

TERRESTRIAL INVERTEBRATES

PHYLUM ARTHROPODA

Class Arachnida

SPIDERS (Order Araneae)

Ammoxenidae

- Barrowammo waldockae* Platnick, 2002

Barychelidae

- Synothele butleri* Raven, 1994

Miturgidae

- Miturga serrata* in Chevron Australia (2005)

Oonopidae

- Orchestina* (Simon, 1882) 'barrow' in Chevron Australia (2005)

Pholcidae

- Trichocyclus* (Simon, 1908) sp. 1 in Chevron Australia (2005)

Prodidomidae

- Wyndundra barrow* Platnick & Baehr, 2006

Selenopidae

- Karaops burbridgei* Crews & Harvey, 2011

Zodariidae

- Spinasteron* (Baehr, 2003) 'harveyi' in Chevron Australia (2005)

SCORPIONS (Order Scorpiones)

Urodacidae

- Aops oncodactylus* Volschenk & Prendini, 2008
Urodacus (Peters, 1861) sp. nov. 'barrow' in Chevron Australia (2005)

PSEUDOSCORPIONS (Order Pseudoscorpiones)

Garypidae

- Anagarypus heatwolei* Muchmore, 1982
Synsphyronus (Chamberlin, 1930) sp. nov. 'barrow' in Chevron Australia (2005)

Syarinidae

- Ideoblothrus nesotymbus* Harvey & Edward, 2007

Chthoniidae

- Tyrannochthonius garththumphreysi* Edward & Harvey, 2008

Class Collembola

SPRINGTAILS (Order Entomobryomorpha)

Entomobryidae

- Acanthocyrtus barrowensis* Zhang, Deharveng, Greenslade & Chen, 2009
Calx (Christiansen, 1958) sp. in Greenslade (2013)
Drepanura liuae Ma, Chun & Greenslade, 2015
Drepanura polychaeta Ma, Chun & Greenslade, 2015
Pseudosinella (Schäffer, 1897) sp. in Greenslade, 2013

Neanuridae

- cf. *Kenyura* Salmon, 1954 in Greenslade (2013)

Neelidae

- Megalothorax* (Willem, 1900) sp. in Greenslade, 2013

Odontellidae

- Caufrenyllodes* Greenslade & Deharveng, 1984

Paronellidae

- Cyphoda* (Delamare-Deboutteville, 1948) sp. in Greenslade, 2013
Metacoelura majeri Ma, Zhao & Greenslade, 2016

Appendix 2. (cont.)

Class Diploda

MILLIPEDES (Order Polydesmida)

Paradoxosomatidae

Boreohesperus dubitalis Car & Harvey, 2013

Haplodesmidae

Genus and species indet. in Car *et al.* (2013)

Class Insecta

FLIES (Order Diptera)

Dolichopodidae

Pseudoparentia niharae Bickel, 2013

Teuchophorus (Loew, 1857) sp. in Bickel (2013)

Thinophilus (Wahlberg, 1844) sp. in Bickel (2013)

TRUE BUGS (Order Hemiptera)

Cicadellidae

Gunawardenea linmaei Fletcher & Moir, 2008

Horouta darwini Fletcher, 2009

Order Hymenoptera

Eulophidae

Elasmus Westwood, 1833 spp.

Elasmus curticornis Gunawardene & Taylor, 2012

LACE WINGS (Order Neuroptera)

Ascalaphidae

Suhpalacsa barrowensis New, 1984

BOOKLICE (Order Psocodea)

Amphientomidae

Lithoseopsis humphreysi (New, 1994)

THRIPS (Order Thysanoptera)

Aeolothripidae

Desmothrips barrowi Pereyra & Mound, 2010

Phlaeothripidae

Gynaikothrips Zimmermann, 1900 sp.

Jacotia rhodorchia Mound & Minaei, 2006

Majerthrips barrowi Mound & Minaei, 2006

Podothrips barrowi Mound & Minaei, 2007

Senithrips psomus Mound & Minaei, 2006

Thripidae

Anaphothrips barrowi Mound & Matsumoto, 2009

Neohydatothrips barrowi Mound & Tree, 2009

SILVERFISH (Order Zygentoma)

Lepismatidae

Hemitelsella transpectinata Smith, 2015

Heterolepisma parva Smith, 2013

Qantelsella maculosa Smith, 2015

Qantelsella aurantia Smith, 2015

Xenolepisma perexiguum Smith, 2015

PHYLUM MOLLUSCA

Class Gastropoda

LAND SNAILS (Order Stylommatophora)

Camaenidae

Quistrachia montebelloensis Preston, 1914

Rhagada barrowensis Johnson, Stankowski, Whisson, Teale & Hamilton, 2013

Rhagada plicata Preston, 1914

TROGLOBITIC AND STYGIAL INVERTEBRATES

PHYLUM ARTHROPODA

Class Arachnida

PALPIGRADES (Order Schizomida)

Hubbardiidae

Draculoides bramstokeri Harvey & Humphreys, 1995

Class Diplopoda

MILLIPEDE (Order Spirobolida)

Trigoniulidae

Speleostrophus nesiotis Hoffman, 1994

Class Insecta

COCKROACHES (Order Blattodea)

Nocticolidae

Nocticola sp. nov. 1 in Humphreys *et al.* (2013)

Order Zgygentoma

Nicoletiidae

Trinemura sp. nov. 1 in Humphreys *et al.* (2013)

Trinemura sp. nov. 2 in Humphreys *et al.* (2013)

Class Malacostraca

SAND HOPPERS (Order Amphipoda)

Bogidiellidae

Bogidomma Bradbury & Williams, 1996

Bogidomma australis Bradbury & Williams, 1996

Hadziidae

Liagoceradocus Barnard, 1965

Liagoceradocus subthalassicus Bradbury & Williams, 1996

Melitidae

Nedsia Barnard & Williams, 1995

Nedsia chevronia Bradbury, 2002

Nedsia fragilis Bradbury & Williams, 1996

Nedsia halletti Bradbury, 2002

Nedsia humphreysi Bradbury & Williams, 1996

Nedsia hurlberti Bradbury & Williams, 1996

Nedsia macrosculptilis Bradbury & Williams, 1996

Nedsia sculptilis Bradbury & Williams, 1996

Nedsia stefania Bradbury, 2002

Nedsia straskraba Bradbury & Williams, 1996

Nedsia urifimbriata Bradbury & Williams, 1996

Order Decapoda

Atyidae

Stygiocaris stylifera Holthuis, 1960

WOODLICE, SLATERS (Order Isopoda)

Armadillidae

Barrowdillo pseudopyrgoniscus Dalens, 1993

Buddelundia hirsuta Dalens, 1992

Buddelundia sp. 2 in Judd & Perina (2013)

Buddelundia sp. 4 in Judd & Perina (2013)

Genus 1 sp. 1 in Judd & Perina (2013)

Genus 2 sp. 1 in Judd & Perina (2013)

Genus 3 sp. 1 in Judd & Perina (2013)

Genus 3 sp. 2 in Judd & Perina (2013)

Genus 4 sp. 2 in Judd & Perina (2013)

Cirolanidae

Haptolana pholeta Bruce & Humphreys, 1993

Order Thermosbaenacea

Halosbaenidae

Halosbaena tulki Poore & Humphreys, 1992

Class Maxillopoda

Order Cyclopoida

Cyclopidae

Dussartcyclops (Barrowcyclops) consensus (Karanovic, 2003) in Karanovic, Eberhard & Murdoch (2011)

Order Harpacticoida

Ameiridae

Inermipes humphreysi Lee & Huys, 2002

Tetragonicipididae

Phyllopodopsyllus wellsi Karanovic, Pesce & Humphreys, 2001